Roseau River HEC-1 Hydrologic Model

prepared for the:

ROSEAU RIVER WATERSHED DISTRICT
P.O. Box 26
Roseau, MN 56751-0026

and the:
U.S. ARMY CORPS OF ENGINEERS
St. Paul District

July 18, 2001

prepared by:

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Introduction

This hydrologic model of the Roseau River Basin was developed for the Roseau River Watershed District for planning purposes, including evaluation of proposed flood control strategies. The model covers the drainage area of the Roseau River to the point where it crosses the International Border and enters Canada near Caribou, Minnesota. The modeled basin includes 1,009 square miles of drainage area in Minnesota and 423 square miles of drainage area in Manitoba.

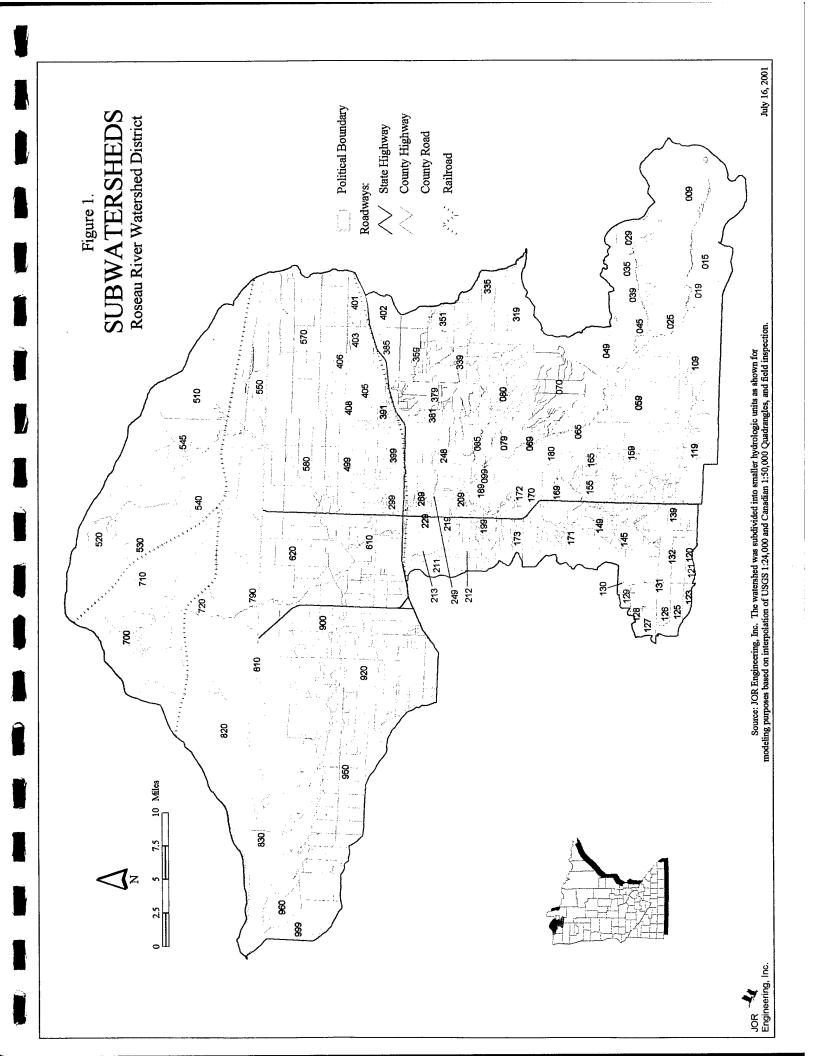
The Minnesota portion of the model was developed as part of the Roseau River Watershed District "Overall Plan" revision process as required by the 1998 Red River Basin Mediation Agreement. The Manitoba portion of the model was developed by a Section 22 Study under the U.S. Army Corps of Engineers. The modeling effort of both sides of the border was done concurrently in order to develop a seamless model. This report covers the entire model.

There are significant differences in the type and extent of data available in Manitoba and Minnesota. In general, the Manitoba data has been transformed to provide the necessary modeling parameters in a format consistent with the way data is presented in Minnesota.

Although the model is fully functional at this time, it is anticipated that refinements will continue to be made as the planning and implementation process evolves. Potential users should ensure that they have the latest, or most appropriate, version of the model.

Watershed

The modeled watershed is the upper portion of the Roseau River Basin as outlined on the map shown in Figure 1. The Roseau River is a major tributary of the Red River of the North. It joins the Red River in Canada near Letellier, Manitoba about 91.5 miles downstream from the modeled area. The drainage area of the Roseau River at its mouth is 2,057 square miles. The modeled portion is 1,432.2 square miles. It consists primarily of cropland, grassland, woodland, and wetlands.



The Minnesota portion of the drainage area is within the geomorphic areas of the Agassiz Lacustrine Plain. Included are the Inter-Beach area, Beltrami Island area, and Agassiz Peatlands (Minnesota Soil Atlas Miscellaneous Report 173-1980). The Inter-Beach area consists of a linear network of beach ridges and low, poorly drained areas. About half the soils are sandy, 10% are organic, and the rest are loamy. The Beltrami Island area consists of a nearly level to slightly depressional lake plain. Most of the soils are loamy and poorly drained. This region also includes some shallow sands over loamy till, areas of clayey soils, and areas of organic soils. Agassiz Peatlands are a low, very poorly drained lake plain. About 75% consists of organic soils generally from 7 to 8 feet deep. The mineral soils are pre-dominantly sandy and poorly drained.

The Manitoba portion of the Roseau River Watershed tributary to Caribou, Minnesota has been subdivided into Lowland Till Plain, Sandilands Upland, Pine Creek Lowland, and Sprague Creek Lowland (Joint Studies for Co-ordinated Water Use and Control in the Roseau River Basin, International Roseau River Engineering Board Report to the International Joint Commission, September, 1975, Appendix A Water Resources).

<u>Sandilands Upland</u> consists primarily of thick sand deposits, overlain along the lower edges by till or lacustrine clays.

Pinecreek Lowlands are mainly peats and lacustrine clays.

<u>Sprague Creek Lowland</u> occupies the eastern portion of the watershed in Manitoba. It is a broad flat area with appreciable local relief developed on glacial till with extensive areas of peat, thick lacustrine clays, and isolated patches of sand.

The portion of the <u>Lowland Till Plain</u> that contributes to the Caribou drainage area is primarily the Menisino Swamp. The swamp is primarily sedge but areas of treed swamp occur at the higher elevations. This area drains into the Roseau River Wildlife Management Area in Minnesota.

Rainfall

Meteorological data used in this model for hypothetical rainstorm events is based on information developed by the (National Weather Service as presented in Technical Papers #40 and 49).

These papers include maps showing expected amounts of point precipitation for storms with durations of 30 minutes to 10 days. The magnitude of storms range from 1 year to 100 years and also include an estimate of the Probable Maximum Precipitation (PMP).

Point Rainfall-Duration-Frequency curves were developed from the meteorological data. They are shown graphically in Figure 2. The curves are based on data at the City of Roseau, which is near the geographic center of the modeled watershed. The rainfall intensity tends to increase from northwest to southeast. Therefore, when analyzing individual sub-watershed strategies, it may be advisable to adjust the rainfall amounts.

Area reduction factors are applied by the hydrologic model to reduce the point precipitation to the amount which would be expected to fall over the entire 1,432 square mile watershed area. Smaller storm areas should be used where appropriate to evaluate strategies at a sub-basin level.

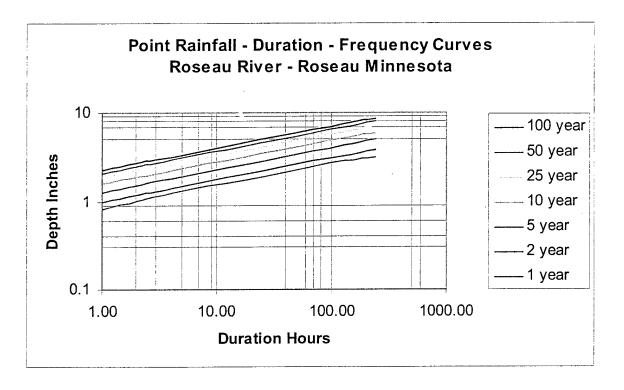
The hypothetical summer storm events that have been analyzed are of 10 days total duration. The precipitation pattern within the 10 days was determined by nesting the shorter duration amounts. In other words, the Maximum precipitation rate of the 6 hour storm is within the 1 day storm which is within the 10 day storm.

Summer Runoff (Rainfall Events)

The amount of runoff generated by rainfall was estimated using the Hydrologic Curve Number (CN) method developed by the Soil Conservation Service (SCS). The curve number takes into account the soil type, topography, land cover, and cultural practices of the watershed, and relates precipitation to runoff. The runoff curve numbers were adjusted for use with 10 day duration storms as recommended by the SCS National Engineering Handbook.

SCS curve numbers were developed using Geographic Information System (GIS) based analysis. So far as known, the best available GIS data has been used. The level of detail of the available data varies considerably.

Figure 2



The required data layers to determine the curve numbers are land cover and hydrologic soil group. A composite map of the hydrologic soil groups is shown in Figure 3. A composite map of the land use data is shown in Figure 4 and a composite map of hydrologic curve numbers is shown in Figure 5.

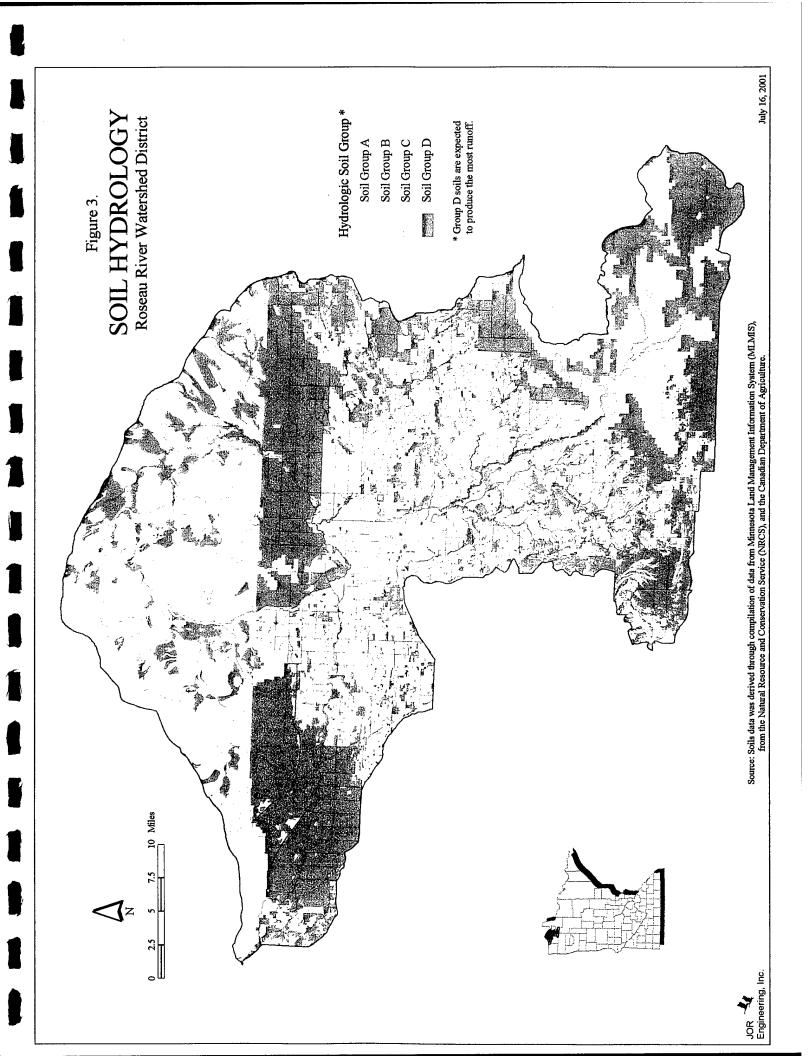
The hydrologic soil groups are based on expected rates of infiltration. They are A, B, C, and D, varying from most to least permeable. For some soil types, two classes are given, depending on whether or not the soil has been drained. These were reclassified by processing the data within the GIS system using the assumption that all lands shown as agricultural had been drained.

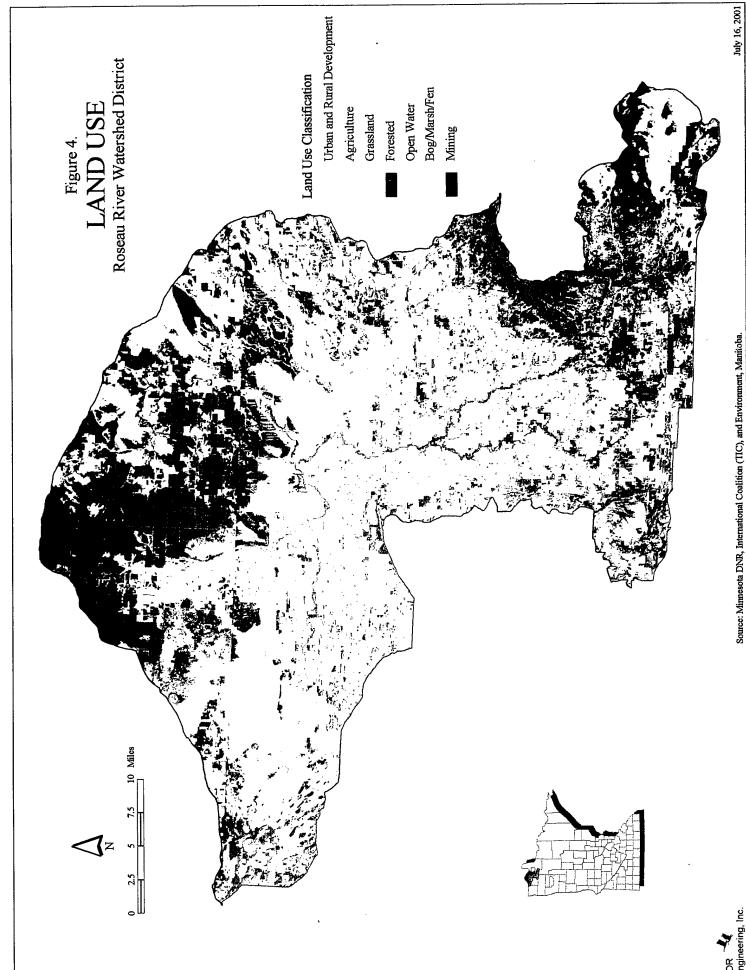
The land cover data used for Minnesota was developed in the early 1990's by the International Coalition (TIC) and by the Minnesota Department of Natural Resources (MNDNR). The TIC data, which covers most of the basin, was developed from 1990 vintage aerial photography. The land cover for the forested, southeastern portion of the basin, was developed from satellite imagery from 1995-1996 by the Manitoba Remote Sensing Center. MNDNR further reclassified the forested area data set into fewer categories.

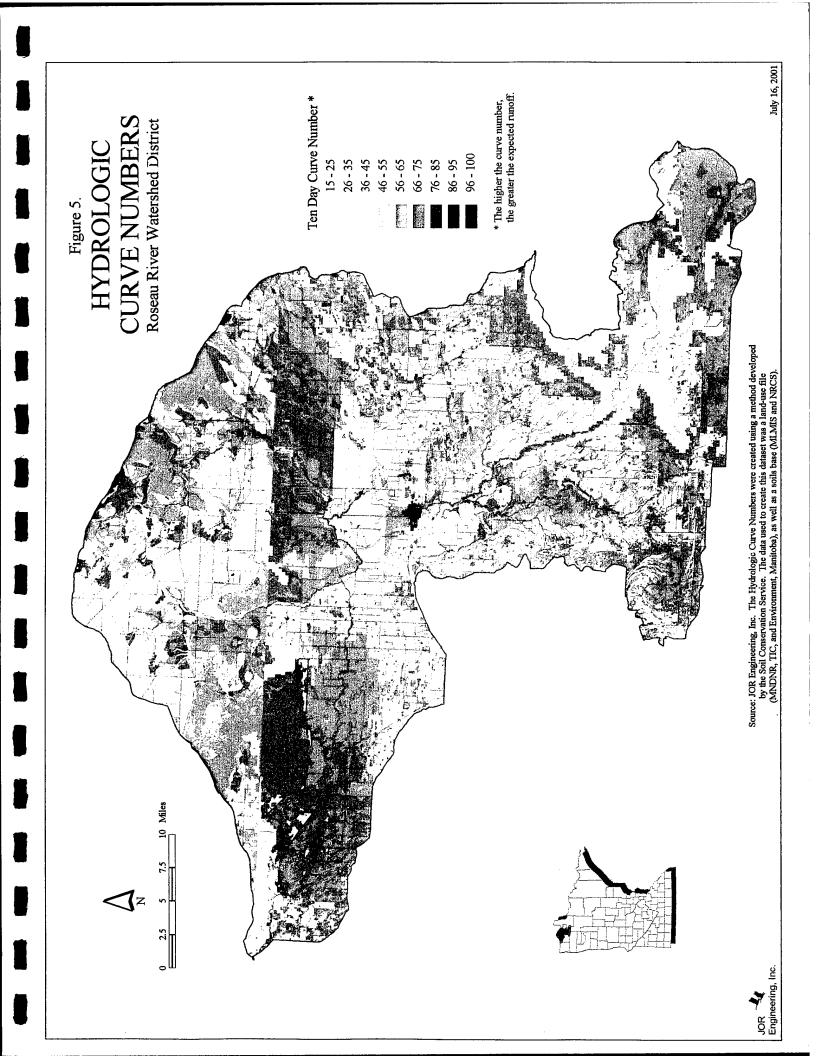
The land cover data used for the Manitoba portion was provided by Environment, Manitoba.

Most of the soils information in Minnesota was from the Minnesota Land Management Information System (MLMIS) 100 meter, generalized soil data. A detailed soil survey of Roseau County has been done by Natural Resource and Conservation Service (NRCS). However, only pre-release detailed soil survey data is currently available from NRCS. Some of the soil survey sheets have been digitized by JOR for the Watershed District. The digitized detailed soils information was used where available.

The GIS soils data for the Canadian portion of the basin was from data developed by the Canadian Department of Agriculture. They do not classify soils into hydrologic groups. The SCS Hydrologic Soils Group was developed based on infiltration rates for each soils class. This was done using criteria described in the (United States Department of Agriculture, Soil Survey Manual, Soil Survey Division Staff, Agriculture Handbook No. 18, Issued October 1993).







Antecedent Moisture Condition II (normal) was assumed to exist prior to all hypothetical storm events. This is generally considered applicable for moisture conditions when storms would occur in Minnesota. (The Minnesota Hydrology Guide (MHG) Table 3-1) provides a table for conversion to AMC III for pre-storm conditions.

Spring Runoff (Snowmelt Events)

Spring snowmelt runoff events are also modeled. The amount of 10 day runoff was based on a map in Figure 1-12 of the Minnesota Hydrology Guide which displays expected 10 day runoff amounts for 100 year recurrence events. The estimates were developed from records which include both rainfall and snowmelt runoff estimates. Since most major floods occur in the spring as a result of a combination of rainfall and snowmelt, this data reasonably represents the spring runoff condition. However, in a strict statistical sense, this flood could occur at any time during the year. Factors are also given to estimate runoff amounts for the 50, 25, and 10 year recurrence events. The amount of runoff estimated for each 10 day runoff event in the Roseau area is listed in Table 1. This amount of runoff was used over the entire modeled basin; however, the runoff amount tends to increase from west to east. For individual project assessment, area specific runoff data should be used.

Table 1
Runoff Estimated for 10-day Event

Year	Runoff (Inches)
10	4.03
25	4.88
50	5.49
100	6.1

The 10 day runoff amounts were distributed in time using the SCS procedure described in (NEH, Chapter 21.10) with the following equation:

$$Q_{(max 24 hour)} = .3*Q_{(10 Day)}$$

This relation means that 30% of the runoff, for the 10 day period, occurs within a 24 hour period. We consider this distribution representative of a typical snowmelt with rainfall event in Northwestern Minnesota. The runoff was distributed equally over the watershed area. Total runoff is simulated in the model by using a SCS curve number of 100 which represents an impervious condition and inputting the runoff amount as precipitation. The assumption that runoff is equally distributed implies that soil infiltration rates are equal. This tends to be true due to the frozen condition of the soil. However, as actual spring flow data is collected, the model can be calibrated to reflect observed differences in spring infiltration rates due to soil type, land cover, or other factors.

Hydrograph Development

For the purpose of hydrograph development at a sub-basin level, the watershed was divided into 97 sub-watersheds. The subwatersheds were shown on the map in Figure 1. Runoff within each sub-watershed is determined, as discussed above, by the SCS curve number method. The curve number determined for each sub-watershed is shown in Table 2. The weighted average 24 hour curve number for the entire drainage area was determined to be 72. This converts to a 10 day curve number of 55 (SCS NEH-4, Table 21.2)

The Clark Unit hydrograph method was used in the model to transform runoff excess to outflow from each sub-watershed. This method requires determination of two runoff parameters related to, time of concentration and storage. The time of concentration was calculated for each sub-watershed. Time of concentration is the travel time required for runoff to flow from the most hydrologically distant point of the sub-watershed to the outlet. The storage coefficients were preliminarily estimated using regional curves developed by the (Red Lake Watershed District, Charles Anderson, P.E.). This uses the relationship: R=K*Tc where R is the storage parameter, K is a drainage/slope coefficient, and Tc is the time of concentration. The Clark Method utilizes time-area curve of the basin for runoff transformation. Synthetic time-area curves were used based on the sub-watershed shape, IE: fan, rectangular, or diamond shape, as presented in the (October 6-9, 1981 workshop on Hydrologic Analysis of Floods, US Army Corps of Engineers in Madison Wisconsin). Sub-watershed hydrologic parameters used in the model are summarized in Table 2.

Table 2
Subwatershed Parameters

Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Roseau River Flowage	RNF9	40.81	75	58	35.53	82.78
Dam 3	RNF15	13.69	68	50	25.65	51.30
Dam 4	RNF19	5.80	73	56	14.88	29.76
RR to Hanson Creek	RNF25	12.52	62	43	18.80	37.60
Dam 1	RNF29	12.73	75	58	34.28	79.87
Dam 2	RNF35	4.90	65	46	22.66	52.80
Winner Dam	RNF39	13.36	65	46	40.79	95.04
Hanson Creek to RR	RNF45	5.59	57	38	16.96	33.92
Hayes Lake	RNF49	18.29	64	45	60.89	121.78
Beaver	RNF59	15.71	66	47	43.26	64.89
Pencer East	RNF65	12.79	67	49	15.54	12.43
RR to Severson Creek	RNF69	2.29	72	54	7.24	7.24
Severson Creek	RNF70	22.25	68	50	17.30	17.30
RR to Bear Creek	RNF79	7.52	70	52	13.14	13.14
Comstocks	RNF80	20.66	72	55	16.80	14.11
Bear Creek	RNF85	5.27	72	54	11.08	8.64
Gage 2	RNF99	2.18	74	57	3.96	2.65
North Branch		216.09	69	51		
Skime	RNF109	28.21	72	55	67.63	157.58
SB to Mickinock Creek	RNF119	24.20	73	56	25.87	51.74
Palmville Sub RNF3	RNF120	1.27	76	60	7.06	14.12
Palmville Sub RNF4b	RNF121	0.95	78	63	9.62	19.24
Palmville Sub RNF4a	RNF123	2.32	78	62	6.98	13.96
Palmville Sub RNF5	RNF125	4.44	72	54	15.40	30.80
Palmville Sub RNF6	RNF126	1.25	74	57	11.52	17.28
Palmville Sub RNF7	RNF127	2.93	67	48	16.27	16.27
Palmville Sub RNF8	RNF128	1.22	66	47	6.25	9.38

Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Palmville Sub RNF9	RNF129	2.90	66	47	7.84	11.76
Palmville Sub RNF10	RNF130	1.29	64	45	5.11	11.91
Palmville wildlife pool	RNF131	7.65	78	62	13.89	32.36
Palmville flood pool	RNF132	0.89	78	62	7.85	18.29
Oseland	RNF139	23.74	73	56	21.3	31.95
Mickinock Creek	RNF145	8.37	72	54	18.97	18.97
Wannaska	RNF149	14.00	72	54	19.28	19.28
SB to Paulson Creek	RNF155	4.45	71	53	6.05	4.05
Gage 43	RNF159	20.07	72	55	20.56	27.76
Paulson Creek	RNF165	3.47	71	53	10.25	10.25
Pencer West	RNF169	6.56	77	61	14.79	14.79
SB to Unamed Creek 1	RNF170	1.65	77	61	6.34	6.34
Unamed Creek 1	RNF171	13.67	72	54	19.15	19.15
SB to Unamed Creek 2	RNF172	5.04	76	60	16.23	16.23
Unamed Creek 2	RNF173	16.03	71	53	16.17	16.17
Gage 3	RNF180	11.52	72	54	18.81	18.81
Sucker Creek	RNF189	0.69	. 72	55	7.44	4.98
Gage 1	RNF199	9.25	74	57	11.09	11.09
South Branch		218.03	73	55		
Gage 50	RNF209	3.24	72	55	8.83	8.83
Stafford 1	RNF211	11.25	70	52	16.80	11.25
Stafford 2	RNF212	1.45	71	53	2.49	1.67
Stafford 3	RNF213	0.70	66	47	5.56	3.73
County Ditch 8	RNF219	6.26	71	53	17.92	17.92
RR to Cow Creek	RNF229	4.83	71	53	12.04	12.04
Gage 44	RNF248	16.90	72	55	15.15	15.15
Cow Creek	RNF249	0.31	75	58	1.76	1.76
Center Street	RNF269	5.07	76	60	10.04	10.04
Roseau River at Center Street		484.13	71	53		
Gage 15	RNF299	5.51	76	60	9.18	9.18
County Road 2	RNF319	19.38	74	57	17.12	16.95

Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Upper Summer Road	RNF335	10.04	69	51	19.28	19.28
Summer Road	RNF339	10.50	67	49	17.20	17.20
Upper SE Hwyll	RNF351	4.32	72	55	12.99	12.99
Gage 12	RNF359	12.44	68	50	13.97	14.39
MN Highway 11	RNF379	20.97	72	54	37.80	56.70
Hay Creek Det I	RNF381	4.14	72	54	20.23	20.23
Norland CD 18	RNF385	8.39	72	55	29.83	59.66
Hay Creek Pool 1	RNF391	2.21	72	55	3.60	3.60
Lower Hay Creek	RNF399	19.76	71	53	24.80	31.00
Hay Creek		112.15	71	53		
Norland sub RNF20	RNF401	2.85	74	57	6.27	9.41
Norland sub RNF30	RNF402	6.43	72	54	39.75	79.50
Norland sub RNF40	RNF403	5.66	67	49	13.51	13.51
Norland sub RNF60	RNF405	7.08	72	55	11.04	11.04
Norland sub RNF65	RNF406	1.71	65	46	5.00	5.85
Norland sub RNF70	RNF408	7.65	67	48	12.55	18.83
MN Highway 310	RNF499	19.26	67	49	18.59	32.35
Roseau River @ MN 310		652.43	71	53		
Mud Creek near Sprague, MB	RNF510	32.18	75	59	71.13	106.70
East Fork Sprague Creek	RNF520	22.42	68	51	43.20	64.80
West Fork Sprague Creek	RNF530	20.42	64	45	48.32	72.48
Sprague Creek at Vassar Road	RNF540	47.64	69	51	43.35	65.03
Sprague Creek near Sprague, MB	RNF545	21.93	74	57	35.70	53.55
Sprague Creek at USGS gage	RNF550	39.01	72	55	52.83	35.40
Lat 2 JD 61	RNF570	54.33	76	60	39.24	58.86
Lower Sprague Creek	RNF580	47.32	78	62	29.00	43.50
Sprague Creek		285.25	73	56		
South Roseau Lake	RNF610	40.91	71	53	10.48	7.02
North Roseau Lake	RNF620	46.20	72	55	40.11	40.11
West Pine Creek	RNF700	33.76	62	43	56.23	37.67
East Pine Creek	RNF710	9.55	60	41	20.36	13.63

Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Pine Creek to Diversion	RNF720	16.68	67	49	7.58	5.08
Pine Creek at Gage 19	RNF790	20.29	73	56	17.76	17.76
Pine Creek		80.28	66	47		
Roseau River at Ross		1105.07	71	54		
RRWMA Pool 1	RNF810	24.88	75	58	13.30	13.30
RRWMA Pool 2	RNF820	89.71	75	58	51.00	76.50
RRWMA Pool 3	RNF830	23.73	70	52	12.50	12.50
Lins Bridge	RNF900	41.99	72	54	14.73	9.87
RR to Big Swamp	RNF920	24.09	75	59	32.83	32.83
Big Swamp	RNF950	88.82	78	63	32.48	48.72
Caribou	RNF960	24.04	71	53	24.04	33.80
Roseau River to Int'l Border	RNF999	9.56	70	52	13.78	13.78
Roseau River at Int'l Border		1431.89	72	55		

Reach Routing

The channel reaches were modeled using the Modified Puls routing method. This method requires the input of an eight point cross section, Mannings (n value) for channel and overbank flow, reach length, slope, and the number of routing steps.

The channel cross section, reach length, and slope were derived from (USGS 7.5 minute topographic maps). Cross section data from the stream gaging program the District operates were also used. The number of routing steps is a calibration parameter for storage routing, it was set to reflect average flows as measured in the Districts stream gaging program. As actual storm events are studied this number should be varied to produce a more accurate hydrograph.

Calibration

Model calibration was done on two rainfall events, the first occurring in May of 1996 and the later occurring in October of 2000. The results of this calibration is shown in Figures 6-12. The gage on Sprague Creek was not in operation for the 1996 flood.

The initial runs of these floods produced higher peaks and shorter durations than the gaged data. The total volume of the events were about equal so calibration was done by adjusting storage upstream of the gaging site. As more gaging data becomes available on the tributaries, this storage can be distributed better.

Results and Conclusions

The model can be used to evaluate the relative change to the flood hydrograph with and without projects which are being considered in the basin. The ability to evaluate relative difference (as apposed to predicting absolute values) is the strength of the hydrologic modeling process.

Tables 3, 4, and 5 show a summary of model predicted peak flows at various points in the basin. These predicted peak flows are considered reasonable. However, care should be taken in using model predicted peak flows for project design purposes. Modeling is only one of the methods normally used for project design.

Figure 6

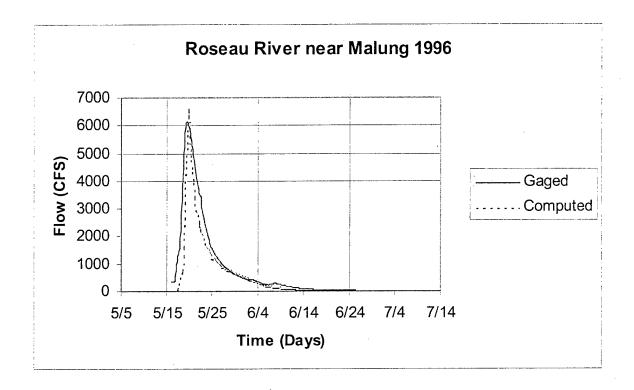


Figure 7

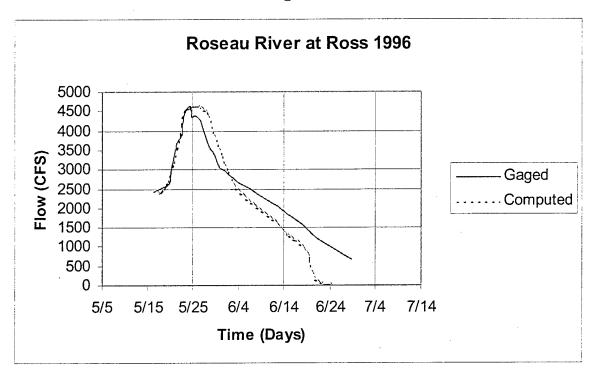


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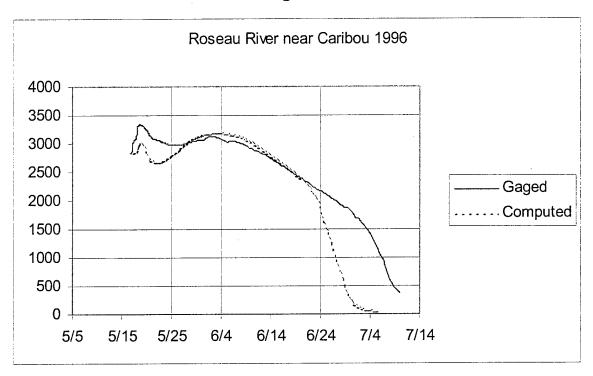


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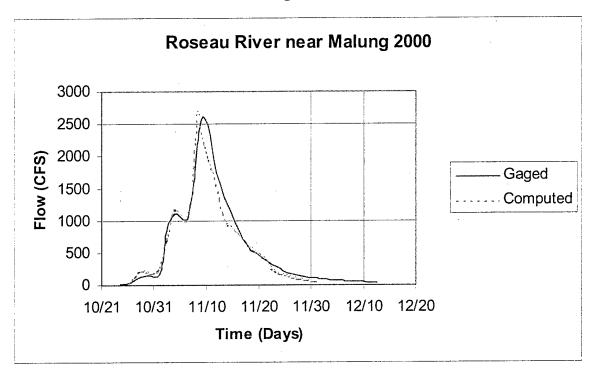


Figure 10

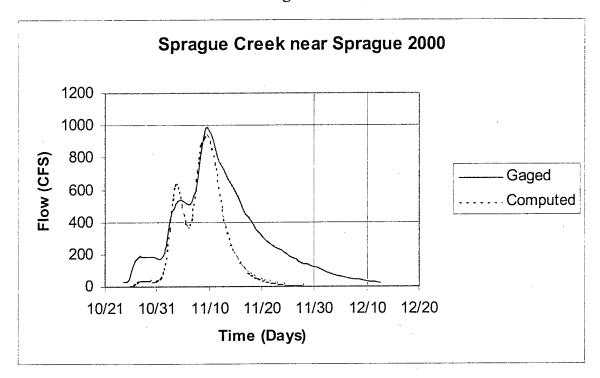


Figure 11

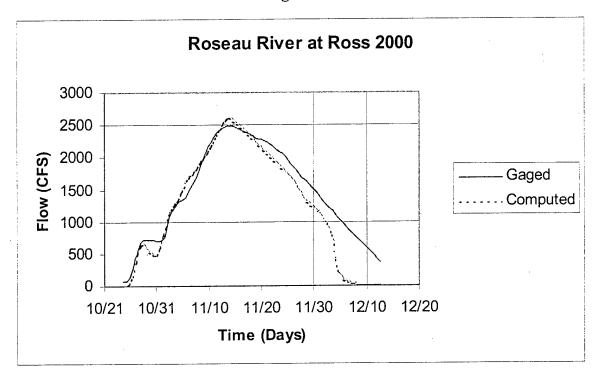


Figure 12

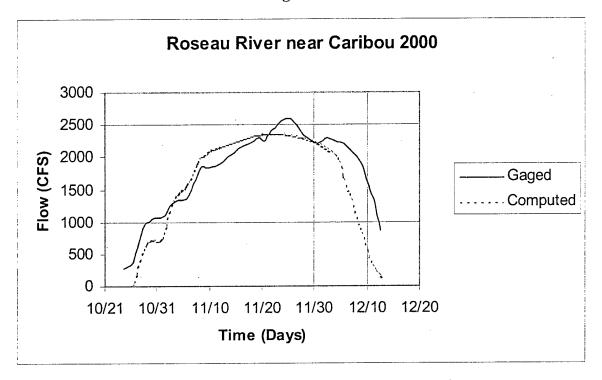


Table 3
Summary of Synthetic Summer Flood Flows

Summar	y of Synti	iene Sui	miner 1.100	Ju 1.10	***3		
Location	Stream Gage ID	Model Id	Drainage Area	1 yr (cfs)	2 yr (cfs)	5 yr (cfs)	10 yr (cfs)
North Branch near Malung	2	adh99	216.09	63	82	295	499
South Fork at Wannaska	36	adh149	125.63	144	170	560	1,027
South Fork near Malung	1	adh199	218.03	148	187	440	973
Roseau River near Malung	50	adh209	437.36	198	258	729	1,411
Roseau River at Roseau	30	adh269	484.13	214	283	793	1,533
Hay Creek at Summer Road	11	adh339	45.43	51	61	245	482
Hay Creek at MN Hwy 11	13	adh379	83.16	83	100	397	779
Hay Creek at Mouth		adh399	112.15	110	133	524	821
Roseau River at CR 28	15	adh400	601.79	275	362	1,067	2,159
Roseau River at MN Hwy 310	. 16	adh499	652.43	296	390	1,224	2,280
Sprague Creek at USGS Gage	57	adh550	183.60	135	160	554	984
Sprague Creek		adh580	285.25	294	338	961	1,673
Pine Creek at Diversion	606	adh720	59.99	12	16	130	345
Pine Creek Diversion	606	rtv720		12	16	130	303
Pine Creek at CR 118	19	adh790	80.28	39	47	171	324
Roseau River at Ross	20	rsv699	1,105.07	646	755	1,365	1,968
Overflow to Two Rivers	40	rtv920		0	0	0	4
Roseau River near Caribou		adh960	1,422.33	732	839	1,448	2,008
Roseau River at Int'l Border		adh999	1,432.89	733	839	1,448	2,008

Table 4
Summary of Synthetic Summer Flood Flows

Summa	ry or Synti	icuc Sumi	ner rioou ri	10 11 3		
Location	Stream Gage ID	Model Id	Drainage Area	25 yr (cfs)	50 yr (cfs)	100 yr (cfs)
North Branch near Malung	2	adh99	216.09	999	1,617	2,052
South Fork at Wannaska	36	adh149	125.63	1,621	2,088	2,500
South Fork near Malung	1	adh199	218.03	2,321	3,568	4,302
Roseau River near Malung	50	adh209	437.36	2,781	4,106	5,230
Roseau River at Roseau	30	adh269	484.13	3,184	4,725	5,840
Hay Creek at Summer Road	11	adh339	45.43	770	1,007	1,209
Hay Creek at MN Hwy 11	13	adh379	83.16	1,185	1,518	1,805
Hay Creek at Mouth		adh399	112.15	1,247	1,610	1,944
Roseau River at CR 28	15	adh400	601.79	4,053	5,340	6,600
Roseau River at MN Hwy 310	16	adh499	652.43	3,781	5,082	6,113
Sprague Creek at USGS Gage	57	adh550	183.60	1,427	1,847	2,164
Sprague Creek		adh580	285.25	2,462	3,164	3,727
Pine Creek at Diversion	606	adh720	59.99	629	878	1,100
Pine Creek Diversion	606	rtv720		493	658	784
Pine Creek at CR 118	19	adh790	80.28	557	755	923
Roseau River at Ross	20	rsv699	1,105.07	2,698	3,772	4,514
Overflow to Two Rivers	40	rtv920		186	380	557
Roseau River near Caribou		adh960	1,422.33	2,342	2,697	3,008
Roseau River at Int'l Border		adh999	1,432.89	2,342	2,697	3,007

Table 5
Summary of Synthetic Spring Flood Flows

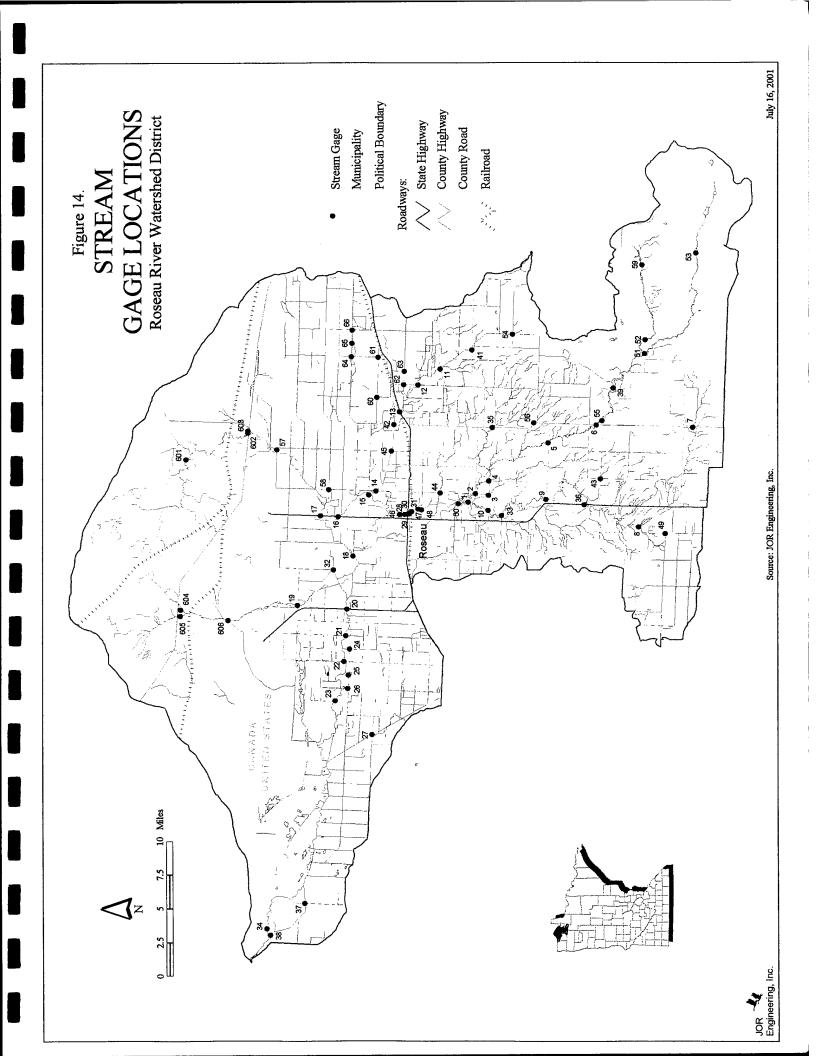
		r	pring 11	1		1	1
Location	Stream Gage ID	Model Id	Drainage Area	10 yr (cfs)	25 yr (cfs)	50 yr (cfs)	100 yr (cfs)
North Branch near Malung	2	adh99	216.09	3,168	3,880	4,365	4,845
South Fork at Wannaska	36	adh149	125.63	2,237	2,721	3,066	3,416
South Fork near Malung	1	adh199	218.03	3,969	4,673	5,224	5,802
Roseau River near Malung	50	adh209	437.36	7,164	8,484	9,485	10,433
Roseau River at Roseau	30	adh269	484.13	8,100	9,587	10,465	11,572
Hay Creek at Summer Road	11	adh339	45.43	928	1,119	1,257	1,396
Hay Creek at MN Hwy 11	13	adh379	83.16	1,622	1,954	2,195	2,440
Hay Creek at Mouth		adh399	112.15	1,902	2,337	2,639	2,954
Roseau River at CR 28	15	adh400	601.79	8,534	10,039	11,171	12,267
Roseau River at MN Hwy 310	16	adh499	652.43	8,038	9,819	10,996	12,142
Sprague Creek at USGS Gage	57	adh550	183.60	2,489	3,020	3,434	3,829
Sprague Creek		adh580	285.25	3,852	4,708	5,337	5,966
Pine Creek at Diversion	606	adh720	59.99	1,127	1,470	1,654	1,838
Pine Creek Diversion	606	rtv720		796	850	850	850
Pine Creek at CR 118	19	adh790	80.28	792	1,182	1,432	1,684
Roseau River at Ross	20	rsv699	1,105.07	5,136	6,741	8,160	9,798
Overflow to Two Rivers	40	rtv920		1,334	1,793	2,235	2,740
Roseau River near Caribou		adh960	1,422.33	3,449	3,687	3,915	4,175
Roseau River at Int'l Border		adh999	1,432.89	3,449	3,687	3,915	4,175

Future Model Improvements

The model has had limited calibration to actual storm events due to the limited extent of actual gaging data available, particularly in Manitoba. We have established a network of stream gaging sites within the watershed. The location of these sites are shown in Figure 14. We recommend that as additional data from these sites becomes available, further calibration of the model should be performed.

The modeling capabilities of the program are somewhat limited in their ability to model the sloped storage that occurs in the Old Roseau Lake Bed and the Big Swamp areas. Within the current model, this is done by an approximation of level pool storage. Ideally, these areas would be analyzed using a dynamic routing model such as Unet.

As the planning process evolves, it is anticipated that the model will need to be further refined to analyze specific flood damage reduction strategies in specific areas.



References

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- → <u>Joint Studies for Co-ordinated Water Use and Control in the Roseau River Basin,</u> International Roseau River Engineering Board Report to the International Joint Commission, September, 1975, Appendix A Water Resources
- → National Weather Service, <u>Technical Papers #40 and 49</u>
- → Soil Conservation Service, National Engineering Handbook (NEH)
- → United States Department of Agriculture, <u>Soil Survey Manual</u>, Soil Survey Division Staff, Agriculture Handbook No. 18, Issued October 1993
- → The Minnesota Hydrology Guide (MHG)
- → Red Lake Watershed District, Charles Anderson, P.E.
- → <u>Hydrologic Analysis of Floods, Workshop</u> U.S. Army Corps of Engineers, October 6-9, 1981 Madison, Wisconsin
- → USGS 7.5 Minute Topographic Maps

APPENDIX A

Basin Schematic

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

LINE

(V) ROUTING

(--->) DIVERSION OR PUMP FLOW

NO.

(.) CONNECTOR

(<---) RETURN OF DIVERTED OR PUMPED FLOW

6	RNF9		
	v		
32	V RSV9		
	v		
	V		
40	RCH9		
47	•	RNF15	
	•	•	
54	ADH15		
	v		
57	V RCH15		
57	KCHI3		
64		RNF19	
		•	
71			
	v		-
74	V RCH19a		
	v		
	v		
81			
	•		
88		RNF25	
	•	•	
95	ADH25	·	
	-		
99	•	RNF29	
22		V	
	•	v	
106	•	RSV29 V	
		v	
114	•	RCH29	
	•		
121	•		RNF35
120	•	, DU2 E	
128		V V	
		v	
131	٠	RCH35	
	•	•	
138			RNF39
	•	•	
145	•	ADH39	
		v	
	•	V	
148		RSV39 V	
		v	
156		RCH39	
	•	•	
163			RNF45
	•	•	
170	•	ADWAS	
1/0		White:	
174	ADH46.		
	V		

177	V RCH46	
184	. RNI	F4 9
104	•	•
191	ADH49 V	•
194	V RSV49	
	v v	
205	RCH49	
212	. RNI	759
	•	•
219	ADH59 V	••
222	V RCH59	
	•	
229	. RNI	
	•	
236	ADH65 V	••
239	V RCH65	•
	•	
246	. RNI	769
	•	•
253	ADH69	
256	RNF	70
	•	•
263	ADH70	
266	V RCH070	
	•	
273	. RNF	79
	•	•
280	ADH79	• •
283	. RNI	F8 0
	•	v v
290	. RCI	180
	•	•
297	•	. RNF85
	•	•
304	. ADI	
200	•	
308	ADH86 V	• •
311	V RCH86	

RNF99

318

325	ADH99							
	v							
	v							
328	RSV99							
	v							
	v							
333	RCH99							
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340		RNF109						
		V						
		V						
347		RCH109						
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354		RCH110						
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361		•	RNF119					
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372		٠.	RNF120					
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		•	v					
	•	•						
380			RCH120					
200	•	•		RNF121				
386	•	•	•					
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		•		V				
393				RCH121				
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		•	•	•				
399		•			RNF123			
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406		•	•					
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				v				
409				RCH123				
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415			ADH124.					
	•	•	•	RNF125				
418		•	•					
		•	•	v				
				v				
425				RCH125				
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431		•	•		RNF126			
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	•	•	•	·	RCH126			
438		•	•		RCH120			
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444	-		_	-		RNF127		
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451						RCH127		
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457				•	•	•	RNF128	
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477	•				
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ADH130					
487			RNF131		
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494		. ADH131	·		
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497		, ,	RNF132		
504					
		. V			
507		RCH132			
		. v			
513		. V RCH133			
313	•				
519			RNF139		
526		ADH139			
		. v . v			
529		RCH139			
535	-		RNF145		
535		•	KNF145		
			•		
542		ADH145		•	
546		i			
549	. RCH146				
F.F.C		RNF149			
556		RNF149			
563	. ADH149	,			
	. '				
566	. RCH149)			
573		RNF155			
580					
583		RNF159			
		. v			
590					
506					
596		KCH160			

RNF129

602		•	RNF165
609		ADH165	
613	. ADH166.		
616	. V . RCH166		
623		RNF169	
630	. ADH169.		
633	. V . RCH169		
640		RNF170	
647	. ADH170.		
651		RNF171	
658			
661	. V . RCH171		
668	· · · · · · · · · · · · · · · · · · ·	RNF172	
675	. ADH172.		
679	· · · · · · · · · · · · · · · · · · ·	RNF173	
686	. v		
689	. V . RCH173		
696	· .	RNF199	
703	. ADH198.		
706		RNF180 V	
713	· · ·	RCH180	
720		•	RNF189
727	· · · · · · · · · · · · · · · · · · ·	ADH189.	
731	. ADH199.		

734	•	RSV199		
	•	V		
720	•	V		
739	•	RCH199		
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746	ADH200			
	V			
	V			
749	RCH200			
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756	•	RNF209		
730				
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763	ADH209			
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766	RCH209		•	
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773	•	RNF211		
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780		•	RNF212	
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787	•	•	•	RNF213
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794	•	ADH211		
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797		RCH211		
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	•	•	RNF219	
804	•	•	KNF219	
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811		ADH220		
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815	ADH221			
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818	RCH221			
825		RNF229		
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832	ADH229			
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836		RNF248		
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843	•	RCH248		
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850	•	:	RNF249	
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857		ADH249		
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861	ADH260 V			
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864				
871		RNF269		
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	v					
881	RCH269					
888		RNF299				
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895	ADH299					
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905		RCH319				
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912	•	•	RNF335			
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924			RCH335			
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931		ADH336.				
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934		RCH336				
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941	•		RNF339			
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958	•	•	RNF351			
967				. <	OUT335	
965			•	RTV335 V		
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968				RCH350		
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978 976	•		DVT351	> OUT351		
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981	•		RCH351			
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991		V RCH352				
J31		RCH352				
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998		•	RNF359			
1005						

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1008		RCH359		
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1017	•	•		OUT351
1015	•	•	RTV351 V	
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1018	·		RCH352	
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1026	•	RCM300		
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1342	. ADH545		
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1399	•		RCH574
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1406	•	ADH575	
		V	
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1409	•	RCH575	
	•	•	
1416	•	•	RNF580
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1423		ADH580	
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1427	ADH456 V		
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1438	•	RNF610	
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1445		:	RNF620
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1452	ADH620		
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1456		RNF700	
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1470	•		RNF710
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1488		RCH711	
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1502	-	ADH720	
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1511	•	RCH720	
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1518	•		RNF790
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1525	-	ADH790	
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1520	ADU600	•	
1529	ADH699 V		
	v		
1532	RSV699		
	v		
	v	•	
1542	RCH699		

1549		RNF900		
1556	ADH900	· ·		
	v			
1559	RCH900			
1500	•	BME 020		
1566		RNF920		
		•		
1573	ADH920 V			
1576	RCH920			
1583	•	RNF810		
1592		•	.<	OUT720
1590	•	•	RTV720	
	•	•	v v	
1593			RC720a	
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1598	•	ADH810	•	
1370		v		
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1601	•	RSV810		
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1608	•		RNF820	
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1615	•			
1615		ADH820 V		
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1615		ADH820 V		
1618		ADH820 V V RSV820		
1618		ADH820 V V RSV820		
1618		ADH820 V V RSV820		
1618 1627 1625		ADH820 V V RSV820 DVT820 V		
1618		DVT820 V V RSV820 DVT820 V V RCH821		
1618 1627 1625		ADH820 V V RSV820 DVT820 V		
1618 1627 1625	: : : : : : :	DVT820		
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1618 1627 1625 1630		DVT821 V RCH821 V RCH822		
1618 1627 1625 1630		DVT821 V RCH821 V RCH822		
1618 1627 1625 1630 1637	ADH930	DVT821 V RCH821 V RCH822		
1618 1627 1625 1630		DVT821 V RCH821 V RCH822		
1618 1627 1625 1630 1637 1644	ADH930 V	DVT820 V V RCH821 V V RCH821 V V V RCH822		
1618 1627 1625 1630 1637	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V RCH822 RNF830		
1618 1627 1625 1630 1637 1644	ADH930 V	DVT820 V V RCH821 V V RCH821 V V V RCH822		
1618 1627 1625 1630 1637 1644 1647 1654	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V RCH822 RNF830	OUT820	OUT820
1618 1627 1625 1630 1637 1644 1647	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V RCH822 RNF830	OUT820	OUT820
1618 1627 1625 1630 1637 1644 1647 1654	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V RCH822 RNF830	OUT820	OUT820
1618 1627 1625 1630 1637 1644 1647 1654	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V V RCH822 RNF830 ADH830	> OUT820 RTV820	OUT820
1618 1627 1625 1630 1637 1644 1647 1654	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V V RCH822 ADH830 V	> OUT820 RTV820	OUT820
1618 1627 1625 1630 1637 1644 1647 1654	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V V RCH822 RNF830 ADH830	> OUT820 RTV820	OUT820
1618 1627 1625 1630 1637 1644 1647 1654 1663 1661 1664	ADH930	ADH820 V V RSV820 DVT820 V RCH821 V V RCH822 ADH830 V V	> OUT820 RTV820	OUT820

1674	. RCH831	
	. v	
	. v	
1681	. RCH832	
1688	ADH940	
	V	
	V	
1691	RCH940	
	•	
1698	. RNF950	
	•	
1705	ADH950	
1705	V	
	v	
1708	RSV950	
	· .	
1716	> OUT920	
1714	DVT950	
	V	
	V	
1719	RCH950	
	•	
1726	. RNF960	
	•	
1733	ADH960	
1755	V	
	v	
1736	RCH960	
	•	
	•	
1743	RNF999	
	•	
1750	ADH999	
	•	
1756	< OI	TT 9 2 C
1754		
1/34	. RTV920	

Appendix B

HEC-1 Input Spring Runoff Events

```
Roseau River Watershed District
ID
        Developed by JOR Engineering, Inc. Crookston, MN
ID
        10 Day Spring Event 6/11/01 Michael Bakken
ID
*DIAGRAM
IT
    480 1JAN94
                    0
                          150
TO
     0
KK RNF9
   Local Drainage to Roseau River Flowage
KM
                 0
                          0
KO
         0
BA 40.81
TN 144.
KM
    100 year
   6.1
PB
KM
   50 year
PB 5.49
KM
    25 year
PB 4.88
KM
   10 year
  4.03
PΒ
PC 0. 0.00527 0.01059 0.01596 0.02139 0.02687 0.03241 0.03801 0.04368 0.04941
PCO.0552 0.06108 0.06702 0.07304 0.07914 0.08532 0.09158 0.09793 0.10438 0.11092
PC0.1175 0.12432 0.13119 0.13818 0.14529 0.15253 0.15991 0.16744 0.17513 0.183
PCO.191 0.1993 0.20776 0.21645 0.22539 0.23460 0.24412 0.25397 0.2642 0.27485
PC0.2859 0.29769 0.31004 0.32318 0.33728 0.35261 0.36957 0.38885 0.41184 0.44238
PC0.5323 0.57169 0.59764 0.61852 0.63652 0.6526 0.66728 0.68088 0.69361 0.70562
PCO.717 0.72792 0.73836 0.7484 0.75808 0.76744 0.77651 0.78532 0.79389 0.80224
PCO.8103 0.81834 0.82612 0.83373 0.84119 0.8485 0.85568 0.86273 0.86965 0.87646
PCO.8831 0.88975 0.89624 0.90264 0.90895 0.91517 0.92131 0.92737 0.93335 0.93925
PCO.945 0.95084 0.95654 0.96217 0.96774 0.97325 0.97871 0.93411 0.98947 0.99474
LS 0 100
                    0
UC 35.53 82.78
* fan
                 0.15
                          0.35
                                 0.65
                                           1
UA
      0
          0.05
KK RSV9
  Roseau River Flowage Impoundment
KΜ
      Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KM
KO
      0
            0
                    0
                            0
                                . 22
RS 1
                            0
           STOR
                   240
* rsv9stor
                                          940
                                                1092
                                                        1245
                                                               1550
SV 240
                   400
                           500
                                  643
           310
* rsv9flow
                                                1225
                                                        1913
                                                               3663
                                  435
                                          800
                           288
SQ 0
             52
                   155
* Rsv9elev
                                         1233 1233.5
                                                               1235
                                                        1234
                                 1232
SE 1230 1230.5
                  1231 1231.5
KK RCH9
    North Branch Downstream of Roseau River Flowage
KM
                 0 0
KO
     0 0
                   0
                            0
RS
    1
          FLOW
                         11200
                               0.0004
RC 0.125
          0.035
                 0.125
* rch9
                   750
                           756
                                  780
                                          786
                                                 900
                                                        2800
RX 0
           700
                                                        1230
RY 1230
                                         1224
                                                1225
           1225
                  1224
                          1218
                                 1218
KK RNF15
KM local drainage to DNR dam 3 Non-functional
KO 0
                     0
                            0
           0
BA 13.69
           100
LS 0
                     0
UC 25.65
           51.3
* diamond
UA 0
           0.09
                  0.34
                          0.64
                                  0.9
KK ADH15
  0
              0
                     0
                             0
                                   22
KO
НC
      2
KK RCH15
    North Branch Downstream of DNR dam 3
```

```
KO 0 0
RS 2 FLOW
       0
              0 0
             0.125 12800 0.0004
RC 0.125
        0.035
* rch15
                                        1400
                                  1036
RX 0
         820
               1000
                    1006
                           1030
RY 1225
                    1213
                          1213
                                  1219
                                        1220
         1220
              1219
KK RNF19
KM Local Drainage to DNR dam 4 Non-functional
        0 0 0
KO
    0
BA 5.8
LS 0
        100
UC 14.88
        29.76
* diamond
UA 0
                            0.9
                     0.64
         0.09
               0.34
KK ADH19
                0
                      0
                             22
         0
KO 0
HC
    2
KKRCH19a
KM North Branch downstream of DNR dam 4
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
                    9400 0.0011
RC 0.125
        0.035 0.125
* rch19a
                                  726
                                        990
                                              1690
RX 0
        510
              690 696
                           720
             1209 1203 1203
                                  1209
                                        1220
RY 1225
        1220
KK RC19b
KM North Branch downstream of DNR dam 4
KO 0 0 0 0 22
RS 2 FLOW 0 0
        0.035 0.125 26000 0.0012
RC 0.125
* rch19b
        200
             280 286 318
                                  324
                                        390
                                               450
RX 0
        1200 1195 1188.5 1188.5
                                        1200
                                  1195
RY 1210
KK RNF25
KM Local drainage to North Branch at Hanson Creek
KO 0 0 0 0 22
BA 12.52
LS 0
         100
                0
UC 18.8
       37.6
* rectangle
UA 0 0.2
              0.4 0.6
                            0.8
KK ADH25
KM North Branch Upstream of Hanson Creek
KO 0 0 0 0
HC 2
KK RNF29
KM DNR dam 1 on Hanson Creek
KO 0 0
                0
                             22
BA 12.73
LS 0
         100
                 0
UC 34.28 79.87
* fan
UA 0
                     0.35
                            0.65
                                    1
        0.05
             0.15
KK RSV29
KM DNR dam 1 on Hanson Creek
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
                     0
KO 0 0
RS 1 STOR
                0
                             22
                320
                       0
* rsv29stor
                            670
                                   810
                                         960
                                              1360
SV 320 370
                450
                      650
* rsv29flow
SQ 0 57.5
                            558
                                   934
                                        1310
                                               4235
                166
                      319
* rsv29elev
              1220 1220.5
                            1221 1221.5
                                        1222
SE 1219 1219.5
KK RCH29
```

```
KM Hanson Creek downstream of DNR dam 1
KO 0 0 0 0 0 RS 2 FLOW 0 0
RC 0.125 0.035
                0.125
                      6000 0.0009
* rch29
                                      821
                                             1100
                                                    1480
RX 0
          400
                 800
                        803
                                818
         1215
                1214
                      1211
                              1211
                                      1214
                                             1215
                                                    1220
RY 1220
KK RNF35
KM Non-functional DNR dam 2 on Hanson Creek
   0 0
                0
                      0
                              22
BA 4.9
LS 0
           100
UC 22.66
          52.8
* diamond
                                       1
UA 0
          0.09
                 0.34
                        0.64
                                0.9
KK ADH35
KO 0
HC 2
           0
                  0
                         0
                                 22
HC
KK RCH35
KM Hanson Creek from DNR dam 2 to Winner Dam
KO 0 0
RS 5 FLOW
               0 0
RC 0.125 0.035
                0.125 17000 0.0006
                                       . 0
* rch35
           110
                 310
                        316
                                336
                                       342
                                              600
                                                    1000
RX 0
RY 1210
                                      1204
                1204
                        1198
                               1198
                                             1205
                                                    1210
         1205
KK RNF39
KM Local drainage to Winner Dam KO 0 0 0 0
BA 13.36
LS 0
         100
UC 40.79 95.04
* diamond
UA 0
          0.09
                 0.34
                        0.64
                                0.9
KK ADH39
KO . 0
           0
                  0
                         0 .
                                 22
НC
     2
KK RSV39
KM Winner Dam impoundment on Hanson Creek
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO 0 0
RS 1 STOR
                0
                       0
                                22
                   5
                           0
* rsv39stor
SV 5
           21
                   30
                          65
                                120
                                       220
                                              370
                                                     470
                                                            580
* rsv39flow
                                              560 920
                        75
SQ 0
                  32
                                170
                                       320 -
                                                           1500
* rsv39elev
                                             1207 1207.5
SE1201.5 1202
                 1203
                      1204
                               1205
                                      1206
                                                           1208
KK RCH39
KM Hanson Creek Winner dam to North Branch KO 0 0 0 0 22 RS 1 FLOW 0 0
RC 0.125 0.035
                0.125 20500 0.0013
* rch39
          700
RX 0
                                             1290
                                                    1680
                 990
                        996
                               1036
                                      1042
RY 1205 1200
                                      1194
                                             1200
                1194
                       1182
                              1182
KK RNF45
KM Local drainage to outlet of Hanson Creek KO 0 0 0 0 22
BA 5.59
LS 0
          100
                  0
UC 16.96 33.92
* rectangle
UA 0
           0.2
                0.4
                         0.6
                                0.8
KK ADH45
```

```
KM Hanson Creek outflow
KO 0
HC 2
                                  22
           0
                  0
KK ADH46
                   0
                            0
                                  22
KO 0
             0
HC
     2
KK RCH46
KM North Branch from Hanson Creek to Hayes Lake
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 11000 0.0007
* rch46
          200
                                 390
                                        398
                                               460
RX 0
                350
                       358
RY 1190 1175 1169
                       1161
                                1161
                                        1169
                                               1175
                                                      1190
KK RNF49
KM Local drainage to Hayes Lake
                                  22
     0 0 0
                       0
KO
BA 18.29
LS 0 100
                   0
UC 60.89 121.78
* diamond
UA 0
           0.09
                  0.34
                       0.64
                                 0.9
KK ADH49
KO 0
HC 2
          0
                   0
                       0
                                  22
HC
KK RSV49
KM Hayes Lake Dam
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO 0
RS 1
          0 0 0
STOR 1640 0
                               22
* rsv49stor
                       1290
                                              1750
                                                              2050
                                                                     2270
                                1640
                                        1680
SV 0 180
                  595
SV 2510
          2760
                  3000
                         3070
                                 3180
                                        3250
* rsv49flow
                  0
                         0
                                 0
                                              72
                                                                     1235
SQ 0
                                        19
                                                       213
                                                               640
                4060 4610
                                5140
                                        8150
SQ 2000 2950
* rsv49elev
                1160 1165 1167 1167.2 1167.5
                                                                     1170
                                                              1169
SE 1150 1155
SE 1171
         1172
                1173 1173.4 1173.7
                                        1174
KK RCH49

        KM
        North
        Branch
        Hayes
        Lake
        to
        Beaver

        KO
        0
        0
        0
        0
        22

        RS
        1
        FLOW
        0
        0
        0

RC 0.125 0.035 0.125 28200 0.001
                                        0
* rch49
          90
                160
                         168
                                 228
                                        236
                                               690
RX 0
RY 1150
         1135 1130
                       1122
                                1122
                                        1130
                                              1135
KK RNF59
KM Local Drainage to Beaver
     0 0 0
                                  22
KO
BA 15.71
          100
                   0
LS 0
UC 43.26 64.89
* fan
UA 0
         0.05
                  0.15
                         0.35
                                 0.65
KK ADH59
KO 0
           0
                   0
                           0
                                  22
HC
     2
KK RCH59
KM North Branch to Pencer
KO 0 0 0 0
RS 2 FLOW 0 0
                                  22
RC 0.125 0.035
                0.125
                       38000 0.0009
* rch59
                                                     1770
RX 0 110
                1000 1008 1068
                                        1072
                                              1690
```

```
RY 1125 1120 1115 1107 1107 1115 1120
                                                 1125
KK RNF65
KM Local drainage to Pencer East
KO 0 0 0
                        0
                                22
BA 12.79
          100
LS 0
                   0
UC 15.54 12.43
* fan
          0.05
                                       1
TIA 0
                0.15
                       0.35
                              0.65
KK ADH65
           0
KO 0
HC 2
                        0
                  0
                                22
KK RCH65
KM North Branch to Severson Creek
KO 0 0 0 0
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 25509 0.0008
* rch65
RX 0
RY 1095
          80
                 250
                       270
                               330
                                     350
                                            1580
                             1075
               1085
                                                   1095
         1090
                       1075
                                     1085
                                           1090
KK RNF69
KM Local drainage to North Branch at Severson Creek
KO 0 0 0
                      0
BA 2.29
LS 0
          100
                  0
UC 7.24
         7.24
* rectangle
UA 0
          0.2
                  0.4
                        0.6
                               0.8
                                      1
KK ADH69
KO 0
                   0
                          0
                                22
HC 2.
KKRNF070
KM Severson Creek
KO 0 0
                          0
                                22
BA 22.25
LS 0
          100
UC 17.3
         17.3
* fan
UA 0
         0.05
                0.15
                      0.35
                              0.65
KK ADH70
         0
KO 0
HC 2
                 0
                        0
                               22
KKRCH070
KM North Branch to Bear Creek KO 0 0 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125
                      29973 0.0008
* rch70
         80
RX 0
                       270
                                     350
                                           1580
                                                  1680
                 250
                               330
RY 1085 1080 1075
                      1065
                              1065
                                     1075
                                            1080
                                                  1.085
KKRNF079
KM Local drainage North Branch at Bear Creek KO 0 0 0 0 22
BA 7.52
          100
LS 0
                  0
        13.14
UC 13.14
* rectangle
UA 0
          0.2
                 0.4
                        0.6
                               0.8
                                      1
KK ADH79
KO 0
HC 2
           0
                 0
                        0
                                22
KK RNF80
KM Local Drainage Comstocks Bear Creek at Roseau CSAH 9 KO 0 0 0 22
BA 20.66
```

```
LS 0 100
UC 16.8 14.11
               0
* fan
UA 0
                0.15
                     0.35
                           0.65
         0.05
KK RCH80
KM Bear Creek Comstock to North Branch
KO 0 0 0 0 22
RS 3 FLOW 0 0
RC 0.125 0.035
               0.125 28200 0.0008
* rch80
RX 0
          180
                      406
                              456
                                     462
                                           640
                                                  820
                400
RY 1080
                                    1070
         1075
                1070
                      1064
                            1064
                                           1075
                                                  1080
KK RNF85
KM Local drainage Bear Creek at outlet
KO 0 0 0 0 22
BA 5.27
LS 0
         100
                   0
UC 11.08
        8.64
* rectangle
UA 0
          0.2
               0.4
                     0.6
                              0.8
KK ADH85
KM Bear Creek at North Branch
KO 0
HC 2
                               22
           0
                 0
KK ADH86
KO 0
           0
                 0
                       0
HC 2
KK RCH86
KM North Branch from Bear Creek to Malung
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035
               0.125 20800 0.0006
                                     0
* rch86
                                     415
                                           490
                                                  710
RX 0
          260
                350
                      354
                              411
RY 1070
        1055
               1054
                     1050
                             1050
                                    1054
                                           1055
                                                 1070
KK RNF99
KM Local Drainage to Gage 2
KO 0 0 0
               0 0
                              22
BA 2.18
LS 0
          100
                   O
UC 3.96
          2.65
* diamond
UA 0
          0.09
                0.34
                       0.64
                              0.9
KK ADH99
KO 0
HC 2
           0
                 0
                       0
                               22
KKRSV99
KM temporary calibration reservoir
RS 1 STOR
               0
* rsv99stor
SV 0 800
                1200
                     4800
                             6500
                                    7000
                                           7300
                                                 7400
                                                        7800
                                                               8000
* rsv99flow
SQ 0 100
KK RCH99 CNAME
                 200
                                    1500
                                           2500
                                                 3000
                                                        5000
                                                              15000
                      500
                             1000
                G2
KM North Branch gage 2 to South Branch
KO 0 0 0
RS 1 FLOW 0
                     0
                        0
RC 0.125
        0.035
              0.125
                     17800 0.0004
                                     0
* rch99
RX 0
         110
               180
                      186
                              246
                                    252
                                           260
                                                  810
                                           1050
                                                 1055
RY 1055 1050
                                    1044
               1044
                     1038
                            1038
KKRNF109
KM Local drainage South Branch at Skime KO 0 0 0 0 22
BA 28.21
```

```
LS 0 100
UC 67.63 157.58
* fan
UA 0
              0.15 0.35 0.65
         0.05
KKRCH109
KM South Branch Skime to Casperson
KO 0 0 0 0 0 22
RS 2 FLOW 0 0
        FLOW
RC 0.125 0.035 0.125 34800 0.0007
* rch109
              1620 1624 1664
                                  1668
                                        2150
                                               3220
RX 0
         1400
RY 1175 1170
              1165 1161 1161
                                  1165
                                        1170
KKRCH110
KM South Branch Casperson to Mickinock Creek
KO 0 0 0 0 0 22
RS 3 FLOW 0 0
RC 0.125 0.035 0.125 35000 0.0012
* rch110
RX 0
          280
               300
                     305
                            345
                                  349
                                        400
                                               540
RY 1135
              1125
                    1120
                                       1130
         1130
                            1120
                                  1125
                                               1135
KKRNF119
KM Local drainage to South Branch at Mickinock Creek
KO
    0 0 0 0
BA 24.2
LS 0 100
UC 25.87 51.74
* rectangle
              0.4
UA 0
          0.2
                      0.6
                            0.8
KKADH119
KM Combined flow South Branch upstream of Mickinock Creek
KO 0 0 0 0 22
HC 2
KKRNF120
KM Palmville sub RNF3
KM Palmville sub refers to areas developed for the Palmville Flood Control P KO 0 0 0 0 22
BA 1.27
        100
LS 0
UC 7.06 14.12
* fan
              0.15
                    0.35
                             65
UA 0
        0.05
KKRCH120
         0
                       0
KO 0
RS 1
              . 0
                             22
         FLOW
                0
                        0
RC 0.15
                     5500 0.0018
         0.15
               0.15
* rch120
         10 20
                                 1300
                                               1320
                      500
                            800
                                        1310
RX 0
        1169 1168.5
                            1168 1168.5
                                        1169
RY 1170
                     1168
KKRNF121
KM Palmville sub RNF4b
                       0
                            22
BA 0.95
        100
LS 0
                0
UC 9.62 19.24
* fan
              0.15
UA 0
         0.05
                     0.35
                          0.65
KKRCH121
         0
                      0
KO 0
RS 1
                0
                             22
               0
       FLOW
RC 0.15
        0.15
              0.15
                     5500 0.0009
* rch121
              20
         10
RX 0
                     500
                            800 1300
                                        1310
                                             1320
RY 1172 1171 1170.5
                    1170 1170 1170.5 1171
KKRNF123
KM Palmville sub RNF4a
```

KO 0 BA 2.32	0	0	0	22			
LS 0 UC 6.98	100 13.96	0					
* fan	13.30						
UA 0	0.05	0.15	0.35	0.65	1		
KKADH123							
KO 0	0	0	0	22			
HC 2							
KKRCH123							
KO 0	0	0	0	22			
RS 1	FLOW	0	0				
RC 0.15	0.15	0.15	2500	0.004	0		
* rch120							
RX 0	10			800			
	1169	1168.5	1168	1168	1168.5	1169	1170
KKADH124	_		_				
KO 0	0	0	0	22			
HC 2				÷.			
KKRNF125		1					
KM Pa			0	22			
KO 0	0	0	0	22			
BA 4.44		0					
LS 0 UC 15.4		U					
* fan	30.0						
UA 0	0.05	0.15	0.35	0.65	1		
KKRCH125	0.03	0.13	0.00		=		
KO 0	0	0	0	22			
RS 1			0				
RC 0.15		0.15		0.0033	0		
* rch120							
RX 0	10	20	500	800	1300	1310	1320
RY 1170		1168.5				1169	1170
KKRNF126							
KM Pa	lmville	sub RNF6					
KO 0		0	0	22			
BA 1.25							
LS 0		0					
UC 11.52	17.28						
* fan	0.05	0.15	0.25	0 65	1		
UA 0	0.05	0.15	0.35	0.65	1		
KKRCH126	0	0	0	22			
KO 0 RS 1			0	22			
RC 0.15							
* rch120		0.15		0 0006	0		
		0.15		0.0006	0		
ax o			8000			1310	1320
RX 0 RY 1170	10	20	8000 500	800	1300		1320 1170
RY 1170	10		8000 500	800	1300		
RY 1170 KKRNF127	10 1169	20 1168.5	8000 500	800	1300		
RY 1170 KKRNF127 KM Pa	10 1169 lmville	20 1168.5 sub RNF7	8000 500	800 1168	1300		
RY 1170 KKRNF127 KM Pa KO 0	10 1169 lmville 0	20 1168.5 sub RNF7	500 1168	800 1168	1300		
RY 1170 KKRNF127 KM Pa	10 1169 lmville 0	20 1168.5 sub RNF7 0	500 1168	800 1168	1300		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93	10 1169 lmville 0	20 1168.5 sub RNF7 0	500 1168	800 1168	1300		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0	10 1169 lmville 0 100 16.27	20 1168.5 sub RNF7 0	8000 500 1168 0	800 1168 22	1300		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27	10 1169 lmville 0 100 16.27	20 1168.5 sub RNF7 0	8000 500 1168 0	800 1168 22	1300		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127	10 1169 lmville 0 100 16.27	20 1168.5 sub RNF7 0	8000 500 1168 0	800 1168 22	1300 1168.5		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0	10 1169 lmville 0 100 16.27 0.09	20 1168.5 sub RNF7 0 0	8000 500 1168 0	800 1168 22	1300 1168.5		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0 RS 1	10 1169 lmville 0 100 16.27 0.09 0 FLOW	20 1168.5 sub RNF7 0 0	8000 500 1168 0	800 1168 22 0.9	1300		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0 RS 1 RC 0.15	10 1169 lmville 0 100 16.27 0.09 0 FLOW 0.15	20 1168.5 sub RNF7 0 0	8000 500 1168 0	800 1168 22 0.9	1300 1168.5		
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0 RS 1 RC 0.15 * rch120	10 1169 lmville 0 100 16.27 0.09 0 FLOW 0.15	20 1168.5 sub RNF7 0 0	0.64 09000	800 1168 22 0.9 22 0.0006	1300 1168.5	1169	1170
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0 RS 1 RC 0.15 * rch120 RX	10 1169 lmville 0 100 16.27 0.09 0 FLOW 0.15	20 1168.5 sub RNF7 0 0 0.34 0 0.15	0 0 . 64 0 9 0 0 0 5 0 0 5 0 0 5 0 0 5 0 0	800 1168 22 0.9 22 0.0006	1300 1168.5	1169	1320
RY 1170 KKRNF127 KM Pa KO 0 BA 2.93 LS 0 UC 16.27 * diamond UA 0 KKRCH127 KO 0 RS 1 RC 0.15 * rch120 RX	10 1169 lmville 0 100 16.27 0.09 0 FLOW 0.15	20 1168.5 sub RNF7 0 0	0 0 . 64 0 9 0 0 0 5 0 0 5 0 0 5 0 0 5 0 0	800 1168 22 0.9 22 0.0006	1300 1168.5	1169	1320

```
KM Palmville sub RNF8
KO 0 0 0 0
                       0
                             22
BA 1.22
LS 0
          100
                0
UC 6.25
         9.38
* fan
         0.05
                      0.35
                             0.65
UA 0
              0.15
KKRCH128
KO 0
RS 1
          0
                0
                       0
                              22
         FLOW
RS
                        0
RC 0.15
         0.15
               0.15
                      6000 0.0008
* rch120
RX 0
          10 20
                      500
                             800
                                  1300
                                          1310
                                               1320
                                         1169
                                                1170
                             1168 1168.5
RY 1170 1169 1168.5
                      1168
KKRNF129
KM Palmville sub RNF9 KO 0 0 0
                       0
                             22
BA 2.9
LS 0
               0
        100
UC 7.84 11.76
* fan
UA 0
        0.05
              0.15
                      0.35
                             0.65
KKRNF130
KM Palmville sub RNF10
KO 0 0 0 0
                       0
                              22
BA 1.29
        100
                0
LS 0
UC 5.11 11.91
* fan
UA 0
        0.05
                0.15
                      0.35
                             0.65
KKADH130
KO 0
HC 7
                 0
                        0
                               22
HC
KKRNF131
KM Palmville wildlife pool
KO 0 0 0 0
                              22
BA 7.65
LS 0
        100
UC 13.89 32.36
* fan
                      0.35
                0.15
                             0.65
UA 0
        0.05
KO 0 0
HC 2
                 0
                         0
                               22
KKRNF132
0
                              22
BA 0.89
LS 0
         100
                  0
UC 7.85 18.29
* diamond
UA 0
         0.09
                0.34
                      0.64
                             0.9
KKADH132
KO 0
HC 2
          0
                 0
                       0
                              22
KKRCH132
KO 0
RS 1
          0
                  0
                         0
         FLOW
                  0
                        0
RC 0.15
          0.05
                0.15 10560 0.0005
* rch132
RX 0
                                          1320
                                                1325
                 6
                       16
                              24
                                    34
          4
RY 1153
          1151
                1149
                      1144
                             1144
                                   1149
                                          1150
                                                1152
KKRCH133
KO 0
                              22
                        0
         FLOW
                 0
RS 1
```

```
RC 0.15 0.05 0.15 9200 0.0016 0
* rch133
        4
             6 22 30
RX 0
                                46
                                     1320
                                            1325
RY 1148 1146
             1144
                   1136 1136
                                1144
                                       1144
KKRNF139
KM Local drainage to Oseland Gage
KO
     0 0 0 0 22
BA 23.74
LS 0
        100
                0
UC 21.3 31.95
* fan
UA 0
         0.05
               0.15
                     0.35
                          0.65
KKADH139
KO 0
          0
                0
                       0
                            22
HC 2
KKRCH139
         0
              0
                     0
KO 0 0
RS 1 FLOW
                            22
        0.05 0.125 14800 0.0006
RC 0.125
* rch139
RX 0
         140
               200
                    204
                           224
                                 228
                                       305
                                             350
RY 1127
       1120
             1119
                   1115
                         1115
                                1119
                                       1120
                                             1127
KKRNF145
KM Local drainage to Mickinock Creek at Outlet
KO
    0 0 0
                   0 22
BA 8.37
LS 0
        100
               0
UC 18.97 18.97
* fan
UA 0 0.05
             0.15
                     0.35
                           0.65
KKADH145
KM Mickinock Creek
KO 0
HC 2
        0
                0
                       0
                            22
KKADH146
KO 0
HC 2
        0
             0
                       0
                            22
KKRCH146
KM South Branch Mickinock Creek to Wannaska
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 26600 0.0009
* rch146
         90
                    127
                           167
                                 174
                                       305
                                             390
RX 0
              120
RY 1110
        1105
             1100
                    1093
                          1093
                                 1100
                                       1105
                                             1110
KKRNF149
KM Local drainage South Branch at Wannaska
KO 0 0 0 0 0 22
BA 14
LS 0 100 0
UC 19.28 19.28
* fan
UA 0
        0.05
               0.15
                     0.35
                           0.65
                                 1
KKADH149
                     0
KO 0
HC
    2
KKRCH149
KM South Branch Wannaska to Paulson Creek
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 15200 0.0004
* rch149
              300
         175
                          346
                    306
                                       775
                                             800
RX 0
                                 352
RY 1100 1095 1090
                   1084 1084
                                 1090
                                       1095
KKRNF155
```

```
KM Local drainage South Branch at Paulson Creek KO 0 0 0 0 22
BA 4.45
LS 0
         100
                  0
UC 6.05
         4.05
* fan
                            0.65
UA 0
         0.05
                0.15
                      0.35
KKADH155
                0
                        0
                              22
KO 0
          0
HC
    2
KKRNF159
KM Local drainage gage 43 Roseau CD 21 at CSAH4 KO 0 0 0 0 22 c
BA 20.07
         100
LS 0
UC 20.56
        27.76
* fan
                      0.35 0.65
                                    1
UA 0
        0.05
              0.15
KKRCH159
        0
KO 0
RS 1
                       0
                 0
                              22
              0
         FLOW
                        0
RC 0.125
         0.05
              0.125
                      8500 0.0005
                                    0
* rch159
                                        1373
                                                2700
RX 0
          7.5
                15
                       30
                              38
                                    53
RY 1125 1122.5
                           1115
                                   1120 1122.5
                                                1125
                      1115
               1120
KKRCH160
KO 0
RS 1
                0
                        0
                              22
          0
                        0
         FLOW
                      4400 0.0036
                                    0
RC 0.125
         0.05
              0.125
* rch160
                                          300
                                                400
                                   200
RX 0 150
               180
                      185
                            195
                                   1095
                                         1100
                                                1115
RY 1115 1100
              1095
                      1090
                           1090
KKRNF165
KM Local Drainage Paulson Creek at Outlet KO 0 0 0 0 22
BA 3.47
LS 0
        100
               0
UC 10.25 10.25
* fan
                    0.35
                           0.65
UA 0
        0.05
              0.15
KKADH165
KM Combined outflow Paulson Creek
KO 0
HC 2
        0
              0
                     0
KKADH166
KO 0
          0
                0
                        0
                              22
HC
    2
KKRCH166
KM South Branch Paulson Creek to Pencer West
KO 0 0 0 0 0 22
RS 2 FLOW 0 0
RC 0.125 0.035 0.125 29800 0.0004
* rch166
RX 0 160
              500
                                                700
                                   600
                                         650
                     520
                            580
                    1070 1070
RY 1090 1080
              1080
                                   1080
                                         1085
                                                1090
KKRNF169
KM Local Drainage to Pencer West
                             22
KO
    0 0 0
                    0
BA 6.56
        100
LS 0
                0
UC 14.79 14.79
* fan
UA 0
                            0.65
         0.05
                0.15
                      0.35
KKADH169
KO 0 0
                 0
                       0
                              22
```

.

```
HC 2
KKRCH169
KM South Branch Pencer West to Unamed Creek 1
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125
               0.125 17000 0.0005
         0.035
* rch169
          90
                       712
                               752
                                     774
                                           800
                                                   850
RX 0
                 690
RY 1075
         1070
                1065
                       1054
                              1054
                                    1065
                                           1070
                                                  1075
KKRNF170
KM Local draiange South Branch at Unamed Creek 1
KO 0
          0
                 0
                        0
                               22
BA 1.65
LS 0
          100
UC 6.34
          6.34
* general
UA 0 0.13
               0.36
                       0.67
                              0.89
KKADH170
KM South Branch upstream Unamed Creek 1 KO 0 0 0 0 0 22 HC 2
KKRNF171
KM Local Drainage Unamed Creek 1
KO 0 0 0 0 0
                               22
BA 13.67
        100
                 0
LS 0
UC 19.15 19.15
* fan
UA O
        0.05
                0.15
                       0.35
                              0.65
KKADH171
KO 0
          0
                 0
                        0
                               22
HC
     2
KKRCH171
KM South Branch Unamed Creek 1 to Unamed Creek 2
KO 0 0 0 0 0 RS 3 FLOW 0 0
RC 0.125 0.035 0.125 34400 0.0005
* rch171
RX 0
                690
                       712
                              752
                                     774
                                            800
                                                   850
          90
RY 1070
         1065
               1060
                       1049
                            1049
                                    1060
                                           1065
                                                  1070
KKRNF172
KM Local drainage South Branch at Unamed Creek 2
KO 0 0 0 0 22
BA 5.04
LS 0
         100
                   0
UC 16.23 16.23
* diamond
UA 0
         0.09
               0.34
                     0.64
                            0.9
KKADH172
KM South Branch upstream Unamed Creek 2
   0
                     0
KO
        - 0
               0
HC
     2
KKRNF173
KM Local drainage Unamed Creek 2
KO 0 0
                  0
BA 16.03
LS 0
          100
                   0
UC 16.17 16.17
* fan
UA 0
         0.05
                0.15
                       0.35
                              0.65
                                       1
KKADH173
KO 0
HC 2
            0
                   0
                         0
                               22
НÇ
KKRCH173
{\rm KM} \, South Branch Unamed Creek 2 to Gage 1 \,
```

```
KO 0 0 0 0 0 22
RS 3 FLOW 0 0
RC 0.125 0.035 0.125 27000 0.0005
* rch173
                             752
                                   774
                                          800
                                                850
                      712
RX 0
         90
                690
                      1044
                             1044
                                   1055
                                         1060
                                                1065
RY 1065
        1060
               1055
KKRNF199
KM Local drainage to Gage 1
                       0
                              22
KO 0 0 0
BA 9.25
LS 0
         100
UC 11.09 11.09
* fan
UA 0
         0.05
              0.15
                      0.35
                             0.65
KKADH198
KO 0
HC 2
          0
                0
                              22
                        0
HC
KKRNF180
KM Local drainage gage 3 Sec 18/19 T161N R39W KO 0 0 0 0 22
BA 11.52
LS 0
        100
UC 18.81 18.81
* fan
         0.05 0.15 0.35 0.65
UA 0
KKRCH180
KM Sucker Creek Gage 1 to Outlet
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125
         0.05 0.125 9000 0.0023
* rch180
RX 0
RY 1060
                                    155
                                          180
                                                240
          90
               100
                      125
                             130
         1050
              1044
                      1041
                            1041
                                   1044
                                         1050
                                                1060
KKRNF189
KM Local drainage outlet Sucker Creek
KO 0 0 0 0
BA 0.69
LS 0
         100
                 0
UC 7.44
         4.98
* rectangle
                                    1
UA 0
        0.2
              0.4
                       0.6
                             0.8
KKADH189
KM Sucker Creek Outflow
   0
2
        0 0
                        0
                              22
KO
HC
KKADH199
                              22
KO 0
HC 2
KKRSV199
KM temporary calibration reservoir
RS 1 STOR 0
* rsv199stor
SV 0 800
                     4800
                             6500
                                   7000
                                         7300
                                                7400
                                                      7800
                                                             8000
              1200
* rsv199flow
                                   1500
                                         2500
                                                3000
                                                      5000 15000
SQ 0 100
              200
                      500
                            1000
KKRCH199
KM South Branch to North Branch
KO 0 0 0 0 0 RS 1 FLOW 0 0
                              22
RC 0.125 0.035 0.125
                    6000 0.0005
                                    0
* rch199
RX 0
          90
                100
                       106
                             146
                                   152
                                          290
                                                1200
RY 1055
         1040
                1039
                      1033
                            1033
                                   1039
                                         1050
                                                1055
KKADH200
KO 0
          0
              0
                      0
                              22
```

```
HC 2
KKRCH200
KM Roseau River to USGS Gage near Malung
   0 0 0 0
1 FLOW 0 0
KO
RS 1
        0.035
              0.125
                     2400 0.0003
RC 0.125
* rch200
                            493
                                   501
                                         600
          400
               435
                      443
RX 0
                                               1055
RY 1055
                    1034
                          1034
                                  1040
                                       1050
        1045 1040
KKRNF209
KM Local drainage to USGS Gage near Malung Gage 50
KO
    0
        0
              0
                       0
BA 3.24
LS 0
         100
UC 8.83
         8.83
* fan
                      0.35
                            0.65
         0.05
               0.15
UA 0
KKADH209
                0
                       0
                              22
KO 0
          0
НC
    2
KKRCH209
KM Roseau River gage 50 to CD 8
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125
        0.035 0.125
                    1000 0.0003
* rch200
                                   501
                                         600
                                               1600
RX 0
         400 435
                      443
                            493
              1040
                                               1055
                    1034
                            1034
                                  1040
                                         1050
RY 1055
        1045
KKRNF211
KM Local Drainage to Stafford area 1
KO 0 0 0
                      0
BA 11.25
LS 0
         100
                  0
UC 16.8 11.25
* fan
              0.15 0.35 0.65
UA 0
         0.05
KKRNF212
KM Local drainage to Stafford area 2
        0
KO 0
                0
                       0
BA 1.45
LS
   0
          100
UC 2.49
         1.67
* fan
              0.15
UA 0
                      0.35
                            0.65
         0.05
KKRNF213
KM Local drainage to Stafford area 3
KO 0 0 0
                      0
BA 0.7
LS 0
          100
UC 5.56
         3.73
* fan
                            0.65
                                   1
UA 0
         0.05
               0.15
                      0.35
KKADH211
                0 . 0
KO 0
HC 3
          0
                            22
KKRCH211
KM Roseau County Ditch 8 Stafford project to Outlet
KO 0
RS 1
        0 0 0
FLOW 0 0
                           22
         FLOW
         0.05 0.125 17120 0.0005
RC 0.125
* rch211
RX 0
          10
                16
                      31
                            37
                                  52
                                       1372
                    1051
                                  1056 1056.2 1056.5
RY1058.2
         1058
               1056
                            1051
KKRNF219
KM Local Drainage Outlet RCD 8
```

```
KO 0 0 0
                  0
                           22
BA 6.26
LS 0 100
UC 17.92 17.92
* fan
                   0.35
                          0.65
UA 0
        0.05
             0.15
KKADH220
KM Roseau County ditch 8 outflow
KO 0 0 0
                            22
HC 2
KKADH221
        0 0 0
KO 0
HC 2
                           22
KKRCH221
KM Roseau River RCD 8 to Cow Creek
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 8800 0.0003
* rch221
                  3812
1029
                          3862
                                3874
                                      4024
                                            7624
RX 0 3600
            1035
              3800
                         1029
                                1035
                                           1055
RY 1055
        1050
                                      1050
KKRNF229
KM Local drainage Roseau River at Cow Creek
KO 0 0 0 22
BA 4.83
LS 0
       100
UC 12.04 12.04
* fan
             0.15 0.35 0.65 1
UA 0
        0.05
KKADH229
KM Roseau River upstream Cow Creek
КО 0 0 0 0 22
НС 2
KKRNF248
KM Local drainage Cow Creek Gage 44 Sec 31/32 T162N R39W
KO 0 0 0 0 22
BA 16.9
        100
LS 0
UC 15.15 15.15
* fan
        0.05 0.15 0.35 0.65
UA 0
KKRCH248
KM Cow Creek Gage 44 to Outlet
KO 0 0 0 0
RS 1 FLOW 0 0
                           22
        0.05 0.125 4800 0.0023
RC 0.125
* rch248
RX 0
        170
                    194
                          204
                                208
                                      290
                                            380
             190
RY 1050
        1045
             1044
                   1040
                          1040
                                1044
                                      1045
                                            1050
KKRNF249
KM Local drainage outlet Cow Creek
KO 0 0 0 0
BA 0.31
LS 0
        100
UC 1.76 1.76
* rectangle
UA 0 0.2
                           0.8
                                 1
             0.4
                     0.6
KKADH249
KM Cow Creek Outflow
KO 0
HC 2
        0
                      0
                            22
KKADH260
KO 0
HC 2
           0
               0
                      0
                           22
```

KKRCH260

```
KM Roseau River Cow Creek to Center Street
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035
               0.125 11800 0.0003
* rch221
          3600
                 3800
                        3812
                               3862
                                      3874
                                             4024
                                                    7624
RX 0
         1050 1035 1029
RY 1055
                             1029
                                           1050
                                                   1055
                                     1035
KKRNF269
KM Local drainage Roseau River at Center Street
   0 0 0 0 22
KO
BA 5.07
LS 0
         100
                  0
UC 10.04 10.04
* fan
                        0.35
                               0.65
UA 0
         0.05
                 0.15
KKADH269
          0
KO 0
                  0
                         0
HC 2
KKRCH269
KM Roseau River Center Street to Gage 15

KO 0 0 0 0 0 22

RS 2 FLOW 0 0
RC 0.125 0.035 0.125 23500 0.0003
* rch269
RX 11097 13712 20000 20035 20106 20131 20219 23721
RY1043.9 1038.4 1041.3 1024.7 1024.7 1036.8 1035.1 1043.6

        KM
        Local drainage Roseau River Gage 15

        KO
        0
        0
        0
        22

BA 5.51
LS 0
          100
                   0
UC 9.18
          9.18
* diamond
          0.09
               0.34
                        0.64
                                0.9
UA 0
KKADH299
KO 0
HC 2
           0
                  0
                        0
                                22
KKRNF319
KM Local Drainage Hay Creek at County Road 2 Sec 1/12 T161N R37W
    0 0 0 0 22
KO
BA 19.38
LS 0
         100
UC 17.12 16.95
* fan
               0.15 0.35 0.65 1
UA 0
          0.05
KKRCH319
KM Hay Creek County Road 2 to Branch CD 9
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
          FLOW
          0.05 0.125
                      7200 0.0017
RC 0.125
* rch319
               1270 1282 1300
                                     1312
                                            1400
                                                   1650
RX 0 1130
RY 1110
         1105
                1095
                       1089
                              1089
                                     1095
                                            1105
                                                   1110
KKRNF335
KM Upper Summer Road RCD 9 drainage
KO 0 0 0 0 22
BA 10.04
LS 0
          100
                   0
UC 19.28 19.28
* fan
UA 0
                      0.35 0.65
         0.05
               0.15
KKDVT335
KM Split flow west to Summer Road
DTOUT335
* din335
```

```
DI 0
         50
              100
                     200
                             300
                                    500
                                           750
                                                1000
* dout335
DQ 0
                67
                                    333
                                           500
                                                 670
           33
                     133
                              200
KM Branch of RCD 9 west to Hay Creek
KO 0 0 0 0 0
RS 1 FLOW 0 0
RC 0.125
          0.05 0.125
                      8810 0.0005
* rch335
                      1708
                             1712
RX 0
          800
                1700
                                   1720
                                          1722
                                                1724
RY 1110
          1107
                1105
                      1101
                            1101
                                   1105
                                          1106
                                                1107
KKADH336
KO 0
                              22
HC 2
KKRCH336
KM Hay Creek branch RCD9 to Summer Road
KO 0 0 0 0 22
RS 1 FLOW 0 0
         0.05 0.125
                      7800 0.0017
RC 0.125
* rch336
                                          1400
RX 0
         1130
               1270
                      1282
                             1300
                                  1312
                                                1650
RY 1105
                                         1100
         1100
              1090
                     1084
                           1084
                                  1090
KKRNF339
KM Local Drainage Hay Creek at Summer Road
KO
    0
         0 0
                     0
BA 10.5
LS 0
          100
                 0
UC 17.2
         17.2
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
                                    1
KKADH339
          0
                 0
                       0
                              22
KO 0
HC
     2
KKRCH339
KM Hay Creek Summer Road to Branch of RCD 9
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
         FLOW
RC 0.125
                     4400 0.001
         0.05 0.125
* rch339
RX 0
RY 1080
          100
              355.
1075
                3550
                             3580
                                   3592
                                          4000
                                                4800
                      3562
         1078
                      1069
                            1069
                                   1075
                                          1078
                                                1080
KKRNF351
22
BA 4.32
LS 0
         100
                  0
UC 12.99 12.99
* fan
UA 0
         0.05
              0.15
                     0.35
                           0.65
KKRTV335
KM Split flow from Upper Summer Road North
DROUT335
KKRCH350
RS 2
         FLOW
               0
                       0
RC 0.125
         0.05 0.125 10560 0.0014
* rch350
RX 0
           2
                             . 16
                                    24
                                         1320
                                                2640
                 4
                       12
RY 1107
         1106
                1105
                      1101
                            1101
                                   1105 1105.5
                                                1107
KKADH351
KO 0
HC 2
          0
                  0
                        0
                             22
KKDVT351
KM Split flow to Roseau County Road 11
DTOUT351
* din351
```

May Series Seri	DI 0.	100.	200.	400.	600.	800.	1000.	2000.
KKRCH351 KM Branch RCD 9 to Hay Creek KO 0 0 0 0 0 0 0 22 RS 3 FLOW 0 0 0 0 0 22 RS 3 FLOW 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					3.00	400:	500	1000
May	-	50.	100.	200.	300.	400.	500.	1000.
NO		ah BCD (a to Hav	Creek				
RS			-		22			
No					22			
P					0.0007	0		
RX		0,00	*					
RY		750	1320	1328	1332	1340	1342	1344
MO				1084	1084	1088	1090	1092
HC	KKADH352							
KKRCH352 KM Hay Creek branch of RCD9 to Gage 12 KD 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 0 0 00 RC 0.125 0.05 0.125 7400 0.0014 0 RC 0.125 0.05 0.125 7400 0.0014 0 RC 0.125 0 100 3550 3562 3580 3592 4000 4800 RY 1075 1073 1070 1064 1064 1070 1073 1075 KKRNF159 KM Local drainage Hay Creek at Gage 12 KO 0 0 0 0 0 22 BA 12.44 LS 0 100 0 0 22 HC 2 KKADH359 KM 4 AQ 0.09 0.34 0.64 0.9 1 KKADH359 KM HAY Creek Gage 12 to Branch RCD 9 KKACH359 KM HAY Creek Gage 12 to Branch RCD 9 KKCRCH359 KM HAY Creek Gage 12 to Branch RCD 9 KKC 0 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 ** rch359 KK M Upper Hwy 11 split flow DROUT351 KKRCH358 KKR M Upper Hwy 11 split flow DROUT351 KKRCH358 KKR M 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	KO 0	0	0	0	22			
May Creek branch of RCD9 to Gage 12 RCD 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	HC 2							
NO								
RS 1 FLOW 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	_							
No					22			
RX					0 0014	0		
RX		0.05	0.125	/400	0.0014	U		
RY 1075 1073 1070 1064 1064 1070 1073 1075 KKRNF359 KM Local drainage Hay Creek at Gage 12 KO 0 0 0 0 0 22 BA 12.44 LS 0 100 0 0 22 BA 12.44 LS 0 100 0 0 0 22 BA 18.49 * diamond UA 0 0.09 0.34 0.64 0.9 1 KKRADH359 KM Hay Creek Gage 12 to Branch RCD 9 KM 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRCH351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 0 22 RX 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 1050 1058 1060 RX 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 RKRNF8779 KM Local Drainage MN Hwy 11		100	3550	3560	3580	3500	4000	4800
KKRNF159 KM Local drainage Hay Creek at Gage 12 KO 0 0 0 0 0 22 BA 12.44 LS 0 100 0 0 0 22 W1 13.97 14.39 * diamond UA 0 0.09 0.34 0.64 0.9 1 KKADH359 KO 0 0 0 0 0 22 KKCCH359 KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 KX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KKM Upper Hwy 11 split flow DROUT351 KKRCH352 RX 0 2 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKRCH360 KM 149 Creek Branch RCD9 to MN HWY 11 KKCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KM CO 0 0 0 0 0 22 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KM CO 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0								
KM Local drainage Hay Creek at Gage 12 KO 0 0 0 0 0 22 BA 12.44 LS 0 100 0 0 0 22 V diamond UA 0 0.09 0.34 0.64 0.9 1 KKADH359 KO 0 0 0 0 0 0 22 KKRCH359 KM HAY Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 **rch359 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 RC 0.125 0.05 0.125 37920 0.0007 0 RC 0.125 0.05 0.125 37920 0.0007 0 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 RY 1076 1075 1074 1070 1070 1074 1074 1074 1075 KKADH360 RM Hay Creek Branch RCD9 to MN HWY 11 RO 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 RC 0.125 0.05 0.125 4980 0.0009 0 RC 0.125 0.05 0.50 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 RKRNFNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 0 22		20/3	1370		2303	+5.0		_,,,
KO 0 0 0 0 0 0 0 22 BA 12.44 LS 0 100 0 UC 13.97 14.39 * diamond UA 0 0.09 0.34 0.64 0.9 1 KKRDH359 KO 0 0 0 0 0 22 HC 2 KKRCH359 KM HAy Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 * rch359 RX 0 250 550 562 580 592 700 1000 RX 1070 1068 1065 1059 1059 1065 1068 1070 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1070 1068 1075 1074 1070 1070 1074 1074 1075 KKADH360 KKADH360 KM HAY Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 RX 1076 1075 0.05 0.125 4980 0.0009 RX 1076 1075 1074 1070 1070 1070 1070 RX KADH360 RX 0 2 4 12 16 24 500 1000 RX 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 RX 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 RX 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX N 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX N 1060 1058 1055 1049 1049 1055 1058 1060 RX N Local Drainage MN HWY 11 RX Local Drainage MN HWY 11		l draina	age Hay (Creek at	Gage 12			
BA 12.44 LS 0 100 0 UC 13.97 14.39 * diamond UA 0 0.09 0.34 0.64 0.9 1 KKADH359 KO 0 0 0 0 0 22 KKRCH359 KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 KM Upper Hwy 11 split flow DROUTS1 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRCH351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX NKRNFT79 RM Local Drainage MN Hwy 11 KO 0 0 0 0 0 0 22								
* diamond UA 0 0.09 0.34 0.64 0.9 1 KKRDH359 KO 0 0 0 0 0 0 22 HC 2 KKRCH359 KM HAY Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch359 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 RC 1076 1075 1074 1070 1070 1074 1074 1075 KKRCH360 KM HAY Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX 1060 1058 1055 1049 1049 1055 1058 1060 RX 1060 1058 1055 1049 1049 1055 1058 1060								
# diamond UM 0 0.09 0.34 0.64 0.9 1 KKADH359 KO 0 0 0 0 0 0 22 HC 2 KKRCH359 KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch359 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 RC RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	LS 0	100	0					
NA		14.39						
KKADH359 KO								
KO 0 0 0 0 0 0 22 KKRCH359 KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 0 00000 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 0 22 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0.09	0.34	0.64	0.9	1		
HC 2 KKRCH359 KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 22 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 RX 1060 1058 1055 1049 1049 1055 1058 1060 RKKNFNF379 KM Local Drainage MN Hwy 11 KO Local Drainage MN Hwy 11		_						
KKRCH359 KM		0	0	0	22			
KM Hay Creek Gage 12 to Branch RCD 9 KO 0 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO Local Drainage MN Hwy 11 KM Local Drainage MN Hwy 11								
NO		Creek Ga	age 12 to	Branch	RCD 9			
RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 9220 0.0009 0 * rch359 RX 0 250 550 562 580 592 700 1000 RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 KCKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 1 FLOW 0 0 0 RC 0.125 0.05 50 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22	-		_					
RC 0.125								
RX					0.0009	0		
RY 1070 1068 1065 1059 1059 1065 1068 1070 KKRTV351 KM Upper Hwy 11 split flow DROUT351 KKRCH352 RS 4 FLOW 0 0 0 RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22	* rch359							
KKRTV351 KM	RX 0	250	550	562	580	592	700	1000
DROUT351 KKRCH352 RS		1068	1065	1059	1059	1065	1068	1070
DROUT351 KKRCH352 RS								
KKRCH352 RS		r Hwy 11	l split f	TOM				
RS								
RC 0.125 0.05 0.125 37920 0.0007 0 * rch352 RX		FI.OW	0	n				
* rch352 RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RX 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22					0.0007	0		
RX 0 2 4 12 16 24 500 1000 RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 22			0.123	3,520	2.3007	J		
RY 1076 1075 1074 1070 1070 1074 1074 1075 KKADH360 KO 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22			4	12	16	24	500	1000
KO 0 0 0 0 0 22 HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22								1075
HC 2 KKRCH360 KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22								
KKRCH360 KM	KO . 0	0	. 0	0	22			
KM Hay Creek Branch RCD9 to MN HWY 11 KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22	HC 2							
KO 0 0 0 0 0 22 RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22								
RS 1 FLOW 0 0 0 RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 0 22								
RC 0.125 0.05 0.125 4980 0.0009 0 * rch360 RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 22	KO 0				22			
* rch360 RX						•		
RX 0 250 550 562 580 592 700 1000 RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 22		0.05	0.125	4980	0.0009	0		
RY 1060 1058 1055 1049 1049 1055 1058 1060 KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 22		250	ECO		E00	507	700	1000
KKRNF379 KM Local Drainage MN Hwy 11 KO 0 0 0 0 22								
KM Local Drainage MN Hwy 11 KO 0 0 0 0 22		1030	1033	±0 = 9	1049	1000	1000	1300
KO 0 0 0 0 22	KM Local	l Draina	age MN Hv	vy 11				
	KO 0		-	-	22			

```
LS 0
         100
UC 37.8
          56.7
* fan
UA 0
                        0.35 0.65 1
          0.05
                 0.15
KKADH379
KO 0
HC 2
                         0
           0
                  0
                               22
KKRCH379
KM Hay Creek MN Hwy 11 to Hay Creek Proj Det 1
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035
                      5680 0.0004
               0.125
* rch379
RX 0
               2300
         1000
                      2312
                                      2340
                                            4000
                                                   5000
                               2328
RY 1060
          1058
                1058
                       1050
                              1050
                                      1058
                                            1058
                                                   1060
KKRNF381
KM Hay Creek Proj Det 1
               0
                         0
KO 0 0
                                22
BA 4.14
         100
LS 0
UC 20.23 20.23
* fan
UA 0
         0.05
               0.15
                      0.35
                               0.65
                                      1
KKADH381
         0
KO 0
HC 2
                  0
                         0
                                22
KKRCH381
KM Hay Creek Det 1 to Roseau County Ditch 18
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 10820 0.0004
                                      0
* rch381
RX 0
          1000
                 2300
                       2312
                               2328
                                     2340
                                            4000
                                                   5000
RY 1055 1053 1053 1045 1045
                                           1053
                                     1053
KKRNF385
KM Norland sub RNF50 Roseau County Ditch 18 Sec 4/5 T162N R38W KO 0 0 0 0 22
BA 8.39
LS 0 100
UC 29.83 59.66
                  0
* rnf385
UA 0
UA 1
          0.1
               0.24
                      0.46
                               0.65
                                    0.75
                                            0.83
                                                   0.89
                                                          0.94
                                                                 0.98
KKRCH385
KM RCD 18 to Hay Creek
KO 0 0 0
RS 1 FLOW 0
                       0
                                22
                         0
RC 0.08 0.05 0.08 17690 0.001

* rch385

RX 0 5 10 45 53
                               53
                                      57
                                            100
RY1067.4 1067.4 1067.4 1056.14 1056.14 1064.7 1064.7 1064.7
KKRNF391
KM Hay Creek Project Pool #1
KO 0 0 0 0
               0 0
                                22
BA 2.21
LS 0
          100
                   0
UC 3.6
          3.6
* fan
          0.05
UA 0
                 0.15
                      0.35
                               0.65
KKADH391
           0
                  0
                        0
KO 0
                                22
HC
KKRCH391 CNAME
                391
KM RCD 18 Pool#1 to NW Sec 2 T162N R39W
KO 0 0 0 0
```

```
RS 1
         FLOW 0
                        0
RC 0.08
          0.05
               0.08
                       5280 0.0003
* rch391
          5
                10
                       24
                              30
                                    44 5000
                                                 5250
RX 0
                             1042
                                    1049 1049.5
                                                1050
              1049
                       1042
RY 1053
         1052
KKDVT391
KM Split flow RCD 18
DTOUT391
* in391
                       900. 1200.
                                   2100.
DI 0.
         300.
                600.
* out391
DQ 0.
         200.
              400.
                      600.
                             800.
                                   1400.
KKRCH392
KM RCD 18 NW Sec 2 T162N R39W
        0 0 0
FLOW 0 0
KO 0
RS 1
                              22
                       8300 0.0003
RC 0.08
                                     Ω
         0.05
               0.08
* rch392
          5
                                         5000
                                                 5250
                       24
                              30
                                    44
RX 0
                10
               1048
                                    1048 1048.5
                                                 1049
RY 1052
         1051
                      1041
                             1041
KKADH395
KO 0
HC 2
          0
              0 0
                              22
KKRCH395
KM Hay Creek RCD 18 to Outlet
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 12900 0.0004
* rch395
                                    2340
                                          4000
                                                 5000
RX 0
              2300
                     2312
                             2328
         1000
RY 1050
              1048
                     1040
                             1040
                                    1048
                                         1048
                                                 1050
        1048
KKRNF399
KM Local drainage to Lower Hay Creek KO 0 0 0 0 0 22
    0 0 0 0
BA 19.76
        100
                 0
LS 0
UC 24.8
         31
* fan
UA 0
         0.05
              0.15
                       0.35
                             0.65
KKADH399
KM Hay Creek at Outlet
KO 0 0 0
HC 2
                       0
                               22
KKADH400
KM Roseau River at Gage 15 Sec 6/31 T162-163N R39W County Road 28
KO 0
        0 0
                       0
                              22
HC 2.
KKRSV400
KM Storage behind CR 28
KO 0 0 0 0 RS 1 FLOW 0
                        0
                               22
* rsv400stor
SV 0 147
                                    4517
                                          7282
                                               10872 15272 20471
               247
                       847
                             2587
* rsv400flow
                                                 8450 10000 11690
SQ 0 720
              800
                      2190
                             4110
                                    5200
                                          6120
KKRTV391
KM Overflow RCD 18
DROUT391
KKRC391b
RS 1
         FLOW
                 0
                        0
                                    0
RC 0.08
         0.05
                0.08
                     17000 0.0006
* rc391b
          2
                                    28 1300
RX 0
                       14
                              18
                                                 2600
RY 1057
                                    1055 1055.5
                                                 1057
         1056
                1055
                             1050
                      1050
KKADH401
```

KM Ros	eau Rive	r at Sout	side S	ec 31 T1	63N R39W	at late	ral JD61		
KO 0	0	0	0	22					
HC 2									
KKRC391m									
KM Ros	eau Rive	r Gage 15	to Lat	3 Judic	ial 61				
KO 0	0	0	0	22					
RS 1	STOR	0	0						
* stor39	1m								
SV 0	90	132	228	606	2187	2916	3579	4242	5460
* flow39	1m								
SQ 0	500	1000	2000	3000	5000	6000	7000	8000	10000
KKRNF401									
KM Nor	land sub	RNF20 Se	c 28/29	T163N R	37W				
KO 0	0	0	0	22					
BA 2.85									
LS 0	100	0							
UC 6.27	9.41								
* rnf401									
UA 0	0	0.01	0.03	0.09	0.19	0.29	0.51	0.78	0.95
UA 1									
KKRCH401									
KM Lat	3 JD61								
KO 0	0	0	0	22					
RS 1	FLOW	0	0						
RC 0.08	0.05	0.08	5120	0.006	0				
* rch401									
RX 0	5	10	19	27	36	143	243		
RY1079.1	1079	1078	1075	1075	1078	1079	1079.1		
KKRNF402									
KM Nor	land Sub	RNF30							
KO 0	0	0	0	22					
BA 6.43									
LS 0	100	0							
UC 39.75	79.5								
* rnf402									
UA 0	0.19	0.33	0.56	0.79	0.87	0.92	0.93	0.95	0.99
UA 1									
KKADH402									
KO 0	0	0	0	22					
HC 2									
KKDVT402									
KM 50-50	split we	st and no	orth						
DTOUT402	_								
* in402									
DI 0.	10.	20.	30.	40.	50.	100.	200.	500.	1000.
* out402									
DQ 0.	5.	10.	15.	20.	25.	50.	100.	250.	500.
KKRCH402									
KM Lat	3 JD61								
KO 0	0	0	0	22					
RS 1	FLOW	0	0						
RC 0.08				0.006	0				
* rch402									
		10	22	30	42	47	252		
RX 0 RY1075.1	1075	1074	1070	1070	1074	1075	1075.1		
KKRNF403									
KM Nor	land Sub	RNF40							
KO 0		0	0	22					
BA 5.66	=	-	-						
LS 0	100	0							
UC 13.51		=							
* rnf40									
	0.1	0.29	0.5	0.62	0.74	0.8	0.86	0.91	0.95
UA 1					•	_			
KKADH403									

```
0
2
ко
         0
HC
KKRCH403
KM Lat 3 JD 61
KO 0 0
RS 1 FLOW
                          0
                                22
                   0
                   0
                          0
RC 0.08
          0.05
                 0.08
                       9650
                              0.006
* rch403
         5
                                            47 252
                 10
                        22
                                30
                                      42
RX 0
                 1069
                                            1070 1070.1
RY1070.1
         1070
                        1065
                              1065
                                     1069
KKRNF405
KM Norland sub RNF60 KO 0 0 0
                        0
                                22
BA 7.08
LS 0
          100
                   0
UC 11.04
         11.04
* rnf405
UA 0
UA 1
          0.08
                              0.51
                                     0.65
                                            0.82
                                                   0.9
                                                         0.97
                                                                0.99
                 0.18
                       0.31
KKADH405
KM Sec 21/22 T163N R38W
KO 0 0 0 0 HC 2
                                22
KKRNF406
KM Norland sub RNF65
ĸo
   0 0 0
BA 1.71
LS 0
UC 5
          100
                 0
          5.85
* rnf406
                                            0.7
UA 0
                              0.45
                                     0.57
                                                   0.8
                                                         0.89
                                                                0.97
          0.13
                 0.25
                       0.34
UA
     1
KKADH406
KM Sec 21/22 T163N R38W
KO 0 0
HC 2
               0
                                22
KKRNF408
KM Norland Pool area RNF70
KO 0 0
                 0
                          0
                                22
BA 7.65
LS 0
          100
                   0
UC 12.55 18.83
* rnf408
UA 0
UA 1
          0.02
                0.08
                      0.15
                              0.26
                                     0.41
                                            0.61
                                                  0.75
                                                         0.87
                                                                0.93
KKADH408
KO 0
           0
                   0
                        0
                              22
HC
    2
KKDVT408
KM Split Norland flows into BR 5 Lat 3 and Lat 3 flows
DTOUT410
* in410
DI 0.
          35.
                 99.
                       239.
                              443.
                                     696.
                                           1065.
                                                 1515.
                                                        2032.
* out410
DQ 0.
                        80.
                              148.
                                     232.
                                           355.
                                                  505.
                                                         677.
KKRCH420
KM Lat 3 JD 61
                       0
                0
KO 0 0
RS 2 FLOW
                                22
                        0
RC 0.125
          0.05
                0.125
                      24200 0.0006
                                      0
* rch420
          6
RX 0
                   8
                         18
                                24
                                     34
                                           1320
                                                  1325
RY 1054
                                           1050
                                                  1054
          1051
                1050
                                     1050
                       1045
                              1045
KKADH421
          0
                 0
                        0
                               22
KO 0
```

```
HC 2
KKRCH421
KM Roseau River Lat 3 JD 61 to Hwy 310
KO 0 0
RS 1 STOR
               0 0
                  0
                         Ω
* stor421
                                                 12450 14757 18993
SV 0
          312
                 459
                        792
                              2106
                                     7611 10140
* flow421
SQ 0
          561
               1000
                       2000
                              3000
                                     5000
                                           6000
                                                  7000
                                                         8000 10000
KKRTV430
KM Br 5 Lat 3 JD61
DROUT410
KKRCH430
               0
RS 4
          FLOW
                        0
RC 0.125
          0.05 0.125
                      44000 0.0004
* out410
RX 0
           6
                  8
                        18
                               24
                                     34
                                           1320
                                                  1325
                                           1050
                                                  1054
RY 1054
          1051
                1050
                       1045
                              1045
                                     1050
KKADH430
KO 0
HC 2
           0
                  0
                        0
                                22
KKRNF499
KM . Local drainage Roseau River at MN Hwy 310 KO . 0 0 0 0 22
BA 19.26
        100
                 0
LS 0
UC 18.59 32.35
* fan
UA 0
        0.05
               0.15 0.35
                              0.65
KKADH499
KM Roseau River at MN Hwy 310
KO 0 0 0 0 0 HC 2
                                22
KKRNF520
KM East Fork of Sprague Creek
KO 0 0 0 0 0
                                22
BA 22.42
LS 0
         100
UC 43.2 64.8
* fan
UA 0
        0.05 0.15 0.35
                              0.65
KKRNF530
KM West Fork of Sprague Creek
KO 0 0 0 0
BA 20.42
LS 0
         100
UC 48.32 72.48
* fan
UA 0
          0.05
                0.15
                       0.35
                              0.65
                                      1
KKADH530
KO 0
           0
                 0
                        0
                              22
HC
     2
KKRCH530
KM Sprague Creek forks to Vasser Road
KO 0 0 0 0 0 0 RS 6 FLOW 0 0
RC 0.125
          0.04 0.125 40765 0.0006
* rch530
RX 0
          10
               510
                      516
                              534
                                     540
                                          1040
                                                  1050
RY 1080
         1075
               1073
                     1067 1067
                                     1073
                                           1075
                                                  1080
KKRNF540
KM Local drainage to Sprague Creek at Vassar Road KO 0 0 0 0 22
BA 47.64
LS 0
         100
                 0
```

```
UC 43.35 65.03
* fan
UA 0
        0.05
               0.15
                    0.35
                            0.65
KKADH540
                0
                        0
                              22
KO 0
HC 2
KKRCH540
KM Sprague Creek Vassar Road to Mud Creek
KO 0 0 0 0 22
RS 5 FLOW 0 0
         FLOW
        0.04 0.125 56058 0.0005
RC 0.125
* rch540
RX 0 10 510 516 534
RY 1075 1070 1068 1062 1062
         10
                                               1050
                                  540
                                       1040
                                 1068 1070
                                               1075
KKRNF545
KM Local drainage Sprague Creek at Sprague Manitoba KO 0 0 0 0 22
BA 21.93
LS 0 100
                0
UC 35.7 53.55
* fan
UA 0
        0.05
              0.15 0.35
                          0.65 1
KKADH545
KM Sprague Creek at Sprague
KO 0 0 0 0 HC 2
KKRNF510
BA 32.18
LS 0
        100
UC 71.13 106.7
* fan
UA 0
         0.05
              0.15
                     0.35
                            0.65
лларн546
КО 0 0
KKADH546
                0
                      0
                             22
HC
    2
KKRCH546
KM Sprague Creek Sprague to USGS Gage
KO 0 0 0 0 RS 2 FLOW 0 0
              0.125 17973 0.0009
RC 0.125
         0.04
* rch546
* rch546
RX 0 10
                                        1040
              510
                     516
                            534
                                   540
                                               1050
RY 1065 10602 1057
                    1051 1051
                                  1057
                                        1060
                                               1065
KKRNF550
KM Local drainage Sprague Creek at USGS Gage
KO 0 0 0
                      0.
BA 39.01
LS 0
          100
                 0
UC 52.83
         35.4
* fan
                          0.65
                                   1
UA 0
         0.05
              0.15
                    0.35
KKADH550
KM Sprague Creek at USGS gaging station
KO 0 0 0 0 22
HC 2
KKRCH550
KM Sprague Creek USGS Gage to Lat 2 JD 61
KO 0 0 0 0 22
RS 3 FLOW 0 0
        0.04 0.125 32800 0.0006
RC 0.125
* rch550
         50
RX 0
               1850
                     1856 1874
                                  1880
                                        2980
                                               3030
RY 1050 1047
                    1039 1039
              1045
                                1045
                                        1047
```

```
KKRNF570
KM Local Drainage to Upper Lat 2 JD 61 KO 0 0 0 0 22
BA 54.33
                 0
LS 0
         100
UC 39.24
         58.86
* fan
UA 0
          0.05 0.15
                     0.35
                              0.65
KKRTV402
KM Split flow out of RNF402
DROUT402
KKRCH571
          FLOW
                 0
                         0
RS 1
                 0.08 10420 0.0006
RC 0.08
          0.05
* rch571
                 4
                                     30
                                          1300
                                                  2600
                        10
                               24
RX 0
                                     1079 1079.5
RY 1081
                1079
                      1076
                              1076
          1080
KKADH574
KO 0
HC 2
                        0
                                22
                 0
            0
KKRCH574
KM Lat 2 JD 61
KO 0
RS 4
                        0
                   0
                                22
          0
                          0
          FLOW
                   0
               0.125 31460 0.0005
RC 0.125
          0.05
* rch574
          1
                  5
                         9
                               17
                                     21
                                            2621
                                                  2655
RX 0
                                     1042
                                            1043
                                                 1045
RY 1047
                1042
                       1038
                              1038
          1046
KKADH575
KO 0
HC 2
                 0
           0
KKRCH575
KM Sprague Creek Br2 JD 61 to Outlet
KO 0 0 0 0 22
RS 1 FLOW 0 0
        0.04 0.125 9000 0.0005
RC 0.125
* rch575
RX 0
                                     1547
                                            2547
                                                   2555
          15 1515 1521 1541
                                            1033
                                     1032
RY 1036
          1033 1032 1026
                            1026
KKRNF580
KM Local drainage to Sprague Creek at Outlet KO 0 0 0 0 22
BA 47.32
LS 0
UC 29
         100
rectangle
UA 0
          0.2
               0.4
                     0.6
                               0.8
KKADH580
KM Sprague Creek at Outlet
KO 0
HC 2
        0 0
KKADH456
KM Combined flows Roseau River and Sprague Creek
KO 0 0 0 0 22
HC 2
KKRCH456
KM Roseau Rive Sprague Creek to Roseau Lake Bed
KO 0 0 0 0 22
RS 3 FLOW 0 0
RC 0.125 0.035 0.125 27200 0.0002
* rch456
               2640 2665 2718
1034 1021.5 1021.5
RX 0 1320
                                     2743 4063
                                    1034 1034.25
RY 1035 1034.25
KKRNF610
KM South Roseau Lake Bottom
```

```
KO 0
       0 0
                      0
                             22
BA 40.91
LS 0
         100
UC 10.48
         7.02
* rectangle
                             0.8
UA 0
                      0.6
         0.2
                0.4
KKRNF620
KM North Roseau Lake Bottom
KO 0 0 0
                             22
BA 46.2
        100
LS 0
UC 40.11 40.11
* fan
UA 0
       0.05
              0.15 0.35
                            0.65
                                   1
KKADH620
KM Roseau River at Lake Bed
KO 0 0 0 0 0 HC 3
KKRNF700
KM Local Drainage West Pine Creek
KO 0 0 0 0
BA 33.76
LS 0
        100
                0
UC 56.23 37.67
* fan
UA 0
        0.05 0.15 0.35 0.65
KKRCH700
KM West Pine Creek Manitoba Hwy 12 to East Pine Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
                            22
         FLOW
                    1672 0.0014
RC 0.125
         0.05
             0.125
* rch700
RX 0
         750
              1500 1510
                           1518
                                  1528
                                        2278
                                               3000
RY 1100
        1095 1090 1086 1086
                                       1091
                                               1095
                                  1090
KKRNF710
KM Local drainage East Pine Creek
KO 0 0 0 0
                     0 22
BA 9.55
LS 0
        100
UC 20.36
        13.63
* fan
UA 0
         0.05 0.15 0.35 0.65
KKRCH710
KM East Pine Creek Manitoba Hwy 12 to West Pine Creek
KO 0 0 0 0 22
RS 1 FLOW 0 0
         FLOW
RC 0.125
         0.05
             0.125
                    2048 0.0014
* rch710
              1500 1510
RX 0
         750
                            1516
                                  1526
                                        2276
                                               3000
        1091 1090 1086
RY 1095
                          1086
                                  1090
                                       1095
KKADH710
KM Pine Creek near Hwy 12
                    12
KO 0
HC 2
        0 0
                            22
KKRCH711
KM East and West Pine Creek to Diversion
KO 0
RS 1.
       0 0 0 22
FLOW 0
         0.05 0.125 19288 0.0014
RC 0.125
* rch711
RX 0
                                             6000
1095
                            3016
                                  3026
                                         5250
              3000 3010
         750
RY 1095
         1090
              1085
                    1081
                            1081
                                  1085
                                         1090
KKRNF720
KM Local drainage Pine Creek at Diversion
KO 0 0 0 0 22
```

```
BA 16.68
LS 0
         100 . 0
UC 7.58
         5.08
* fan
          0.05
              0.15 0.35 0.65
UA 0
KKADH720
KM Pine Creek Upstream of Diversion
KO 0 0 0 0
HC 2.
KKDVT720
KM Pine Creek Diversion
DTOUT720
* in720
                    500. 1000. 1250. 1500.
DI 0.
          220.
              300.
                                               2000.
* out720
DQ 0.
         220.
               273.
                      407.
                           740.
                                   850.
                                          850.
                                                850.
KKRCH720
KM Pine Creek Diversion to Roseau County Road 118
KO 0
RS 3
        0 0 0
FLOW 0 0
                            22
                                    0
RC 0.125
          0.04
              0.125 37815 0.001
* rch720
                           1192
                                   1196
                                          1700
                                                2410
RX 0
         600
              1180
                     1184
         1047
                                          1047
RY 1050
              1045 10417
                             1041
                                   1045
KKRNF790
KM Local Drainage at RCR 118
KO 0 0 0 0
                              22
BA 20.29
LS 0
         100
                 0
UC 17.76 17.76
* rectangle
UA 0
              0.4
                       0.6
                              0.8
                                    1
         0.2
KKADH790
KM Pine Creek at Lake Bottom
KO 0 0
HC 2
                 0
                              22
KKADH699
KO 0
HC 2
                 0
                         0
                              22
            0
KKRSV699
KM Roseau Lake Bottom
KO 0 0 0
RS 1 FLOW 2430
                              22
                       0
* stor699
SV 0
          500
               1100
                     3000
                           5580
                                 12970 17860
                                               28000 40000
                                                            52260
SV 60590 74010
              84505 144375 179500 203000
* flow699
SQ 0
                732
                             1136
                                   1372
                                          1638
                                                1924
                                                       2222
                                                             2574
          250
                       954
         3868
               4494
                      5200
                             7500
                                   10000
SQ 3084
* elev699
SE1017.1 1024.8
              1026
                    1027
                            1028
                                   1029
                                          1030
                                                1031
                                                       1032
                                                             1033
                            1037
                                   1038
SE 1034 1035 1035.5
                    1036
KKRCH699
KM Roseau River Ross to Lins Bridge
KO 0 0 0 0 22
RS 2 FLOW 0 0
RC 0.125 0.035 0.125 24390 0.0005
                                    0
* rch699
          9
                      3232 3299
                                   3331
                                          5271
                                                5280
RX 0
               3200
RY 1035
        1032
              1030
                     1014
                          1014
                                   1030
                                          1032
                                                1035
KKRNF900
KM Local drainage at Lins Bridge
KO 0 0 0 0 0
                             22
        0
              0 0
BA 41.99
   0
LS
        100
                  0
```

```
UC 14.73 9.87
* rectangle
UA 0
               0.4
                        0.6
                            0.8
           0.2
KKADH900
           0
                 0
                        0
                               22
KO 0
HC
     2
KKRCH900
KM Roseau River Lins Bridge to Big Swamp
KO 0 0 0 0 0 22
RS 2 FLOW 0 0
RC 0.125 0.035
               0.125 24390 0.0004
* rch900
RX 0
          25
               35
                       67
                             134
                                    166
                                           2806
                                                  5280
RY 1035 1030
                                    1028
                                           1030
                                                  1032
               1028
                     1012 1012
KKRNF920
KM Local drainage upstream of Big Swamp KO 0 0 0 0 22
BA 24.09
LS 0
         100
                  0
UC 32.83 32.83
* rectangle
UA 0
                        0.6
                               0.8
                                     1
          0.2
                 0.4
KKADH920
KO 0
HC 2
           0
                  0
                        0
                               22
KKRCH920
KM Roseau River to Roseau River Wildlife Management Pool 2 Outlet
    0 0 0 0
52 FLOW 0 0
KO
RS 52
         FLOW
RC 0.125 0.035 0.125 13000 0.0004
* rch920
RX 0 2640 5280
RY 1025 1024.5 1024
                            5363
1018
                                    5380
                                          8020 10659
                      5296
                                                1025
                                    1024 1024.5
                       1018
KKRNF810 RRWMA Pool 1
KM Local Drainage to RRWMA Pool 1
KO 0 0 0 0
                     0 22
BA 24.88
LS 0
         100
UC 13.3 13.3
* rectangle
                                     1
                     0.6
                            0.8
UA 0
          0.2
                 0.4
KKRTV720
KM Pine Creek Diversion
DROUT720
KKRC720a
                 0
RS 3
          FLOW
                        0
RC 0.05
          0.05
                0.05
                     41517 0.0001
                                      0
* rc720a
                 28
                                            84
RX 0
           10
                        42
                               52
                                     66
                                                   94
RY 1068
          1063
                1063
                       1056
                             1056
                                    1063
                                           1063
                                                  1068
KKADH810
KO 0
HC 2
                 0
                        0
                               22
           0
KKRSV810
KM RRWMA Pool 1
KO 0 0
RS 1 STOR
                 0
                         0
                               22
                2415
                         0
* stor810
SV 2415
         2477
                3968
                       4899
                             4215
                                    4575
                                           5115
                                                  5475
                                                        6415
                                                               6735
* flow810
SQ 0
                     235
                             460
                                     820
                                           1390
                                                 1960
                                                        3035 4735
          8.4
                33
* elev810
SE 1035 1035.2 1035.5 1035.8 1036 1036.2 1036.5 1036.7
                                                       1037 1037.4
KKRNF820
KM Local drainage RRWMA Pool 2
```

```
22
KO 0 0
                  0
BA 89.71
                   0
LS 0
          100
UC
    51
          76.5
* fan
UA 0
          0.05
                 0.15
                       0.35
                              0.65
KKADH820
KO 0
           0
                   0
                         0
                                22
HC
     2
KKRSV820
KM RRWMA Pool 2
KO 0 0
RS 1 STOR
                  0
                         0
                                22
                4450
                         0
* stor820
                                                 14300
                                                       16540 19550
SV 4450
                       8400
                              9500
                                    10800
                                          12800
          5400
                 6800
* flow810
SQ 0
                                           1390
                                                  1960
                                                        3035
                                                              4735
          8.4
                        235
                               460
                                     820
                 33
* elev820
                            1030 1030.2 1030.5 1030.7
                                                       1031 1031.4
SE 1029 1029.2 1029.5 1029.8
KKDVT820
KM Main outlet Roseau River, Emergency Spillway and Secondary Outlet
DTOUT820
* in820
                       235.
                              460. 820. 1390.
                                                 1960.
                                                        3035.
          8.4
                33.
DI 0.
* out820
                              370.
                                     700.
                                          1225.
                                                 1645.
                                                        2345.
                                                               3325.
DO 0.
          0.
                Ο.
                       170.
KKRCH821
KM Roseau County Ditch 17
KO 0 0 0 0 0 RS 1 FLOW 0 0
         0.035
                       3900 0.0001
RC 0.125
               0.125
* rch821
                                     2124
                                           2128
                                                  2134
RX 0
          1050
               2100
                       2108
                              2116
RY 1025
                                     1020
                                           1022
                                                  1025
        1022 1020
                      1016
                            1016
KKRCH822
KM Old Roseau River Channel
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125
                      8800 0.0001
                                     0
* rch822
                                           2500
                                                  4000
         500
                1400
                       1408
                              1548
                                     1556
RX 0
RY 1024
        1022
                1020
                       1016
                            1016
                                     1020
                                           1022
                                                  1024
KKADH930
   0
KO
           0
                 0
                        0
                               22
HC
     2
KKRCH930
KM Roseau River Pool 2 outlet to Pool 3 outlet
KO 0
RS 2
        0 0 0
FLOW 0 0
         FLOW
RC 0.125 0.035 0.125 15200 0.0004
* rch930
RX 0 2640
                5280
                       5296
                              5363
                                     5380
                                          8020
                                                 10659
RY 1020 1019.5
                                    1019 1019.5
                                                1020
                1019
                       1013
                             1013
KKRNF830
KM Local drainage RRWMA Pool 3
KO
   0 0
               0
                      0
                               22
BA 23.73
          100
                   0
T.S 0
UC 12.5
         12.5
* fan
                     0.35
                              0.65
UA 0
         0.05
                0.15
KKRTV820
KM Pool 2 outflow to Pool3
DROUT820
KKADH830
```

```
0
2
KO
        0 0 0
HC
KKRSV830
KM RRWMA Pool 3
KO 0 0
RS 1 STOR
                  0
                          0
                                22
                2700
                          0
* stor830
SV 2700 3400
                              6750
                                     7750
                                           9700
                                                 12900 16650
                4500
                       5800
* flow830
SQ 0
                 33
                                                       2980
          8.4
                       185
                              355
                                     620
                                           1040
                                                  1925
* elev830
                             1025 1025.2 1025.5
SE 1024 1024.2 1024.5 1024.8
                                                  1026 1026.5
KKRCH831
KM Outlet Channel Pool3
                       0
KO 0 0 0
RS 1 FLOW 0
                               22
                       2920 0.0001
RC 0.125
         0.05 0.125
* rch831
RX . 0
                1400
                       1410
                              1420
                                    1430
                                           2100
          700
RY 1023
         1022
                1021
                       1016
                              1016
                                    1021
                                           1022
                                                  1023
KKRCH832
KM Old Roseau River Channel
KO 0 0 0 0 0 RS 1 FLOW 0 0
                               22
               0.125 1150 0.0001
RC 0.125
          0.05
* rch832
          700
                1400 1412
                             1512
                                    1514
                                           2100
                                                  3000
RX 0
RY 1023
         1022
                1021
                       1015
                              1015
                                    1021
                                           1022
                                                  1023
KKADH940
KO 0
                 0
                               22
HC 2
KKRCH940
KM Roseau River pool 3 to end of Big Swamp
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 34000 0.0004
* rch940
                     5296 5363
                                    5380
                                           8020 10659
RX 0 2640
               5280
                                    1018 1018.5
                                                1019
                     1012 1012
RY 1019 1018.5
               1018
KKRNF950
KM Local drainage Big Swamp KO 0 0 0
BA 88.82
LS 0 100
UC 32.48 48.72
                   0
* rectangle
UA 0
          0.2
                 0.4
                        0.6
                               0.8
                                     1
KKADH950
KO 0
HC 2
           0
                  0
                          0
                                22
KKRSV950
KM Big Swamp Storage
KO 0 0 RS 1 STOR
               0
                  0
                          0
* stor950
                                          37000
                                                             69000
SV 0
         2000
                6000 13000
                             21000
                                    29000
                                                 45000
                                                       53000
* flow950
                                                         3500
                                                               4100
                                           2900
                                                  3200
SQ 0
          700
                1300
                       1900
                              2300
                                    2600
KKDVT950
KM Flow transfer to Two Rivers
DTOUT920
* in920
DI 0. 2000. 3513. 3699.
                             4403.
* out920
                            1083.
DQ 0. 0. 533.
                       619.
```

```
KKRCH950
KM Roseau River Big Swamp to USGS Gaging Station
KO 0 0 0 0 22
RS 3 FLOW 0 0
         0.035 0.125 32900 0.0002
RC 0.125
* rch950
               2200 2220 2275
                                             2900
                                                  3250
RX 0
                                    2295
          1600
RY 1020
          1018
               1015
                      1005 1005
                                      1015
                                           1018
                                                  1020
KKRNF960
KM Local drainage to USGS Gage near Caribou KO 0 0 0 0 22
         0
BA 24.04
LS 0
          100
                  0
UC 24.04
        33.8
* rectangle
                0.4
                                0.8
UA 0
                         0.6
           0.2
KKADH960
KO 0 0
HC 2
                  0
                         0
                                22
KKRCH960
KM Roseau River Caribou to International Border
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
               0.125 12200
                                       0
RC 0.125
         0.035
                              .0003
* rch960
                                                    3250
                                     2295
                                             2900
RX 0
         1600
                 2200
                      2220
                               2275
         1013
               1010
                      1000
                                     1010
                                            1013
                                                    1015
RY 1015
                               1000
KKRNF999
KM Local Drainage Roseau River at Border KO 0 0 0 0 22
BA 9.56
LS 0
          100
UC 13.78 13.78
* rectangle
UA 0
                        0.6
                                0.8
                0.4
          0.2
KKADH999
KM Roseau River at International Border
KO 0 0 0 0 0 HC 2
KKRTV920
KM Diverted flow to Two Rivers
DROUT920
```

zz

Appendix C

HEC-1 Input Summer Rainfall Events

```
ID
         Roseau River Watershed District
         Developed by JOR Engineering, Inc. Crookston, MN
ID
         10 Day Summer Event 6/11/01 Michael Bakken
ID
*DIAGRAM
         1JAN94
                      0
                            150
IT
    480
IO
JD
            1432
                                                                           5.00
                                   2.25
                                           2.71
                                                   3.00
                                                           3.55
                                                                  4.23
PH
     1
                   7.99
                           8.70
PH
   5.85
            7.00
                                                   2.76
                                                           3.25
                                                                  3.85
                                                                           4.59
PH
    2
                                   2.09
                                           2.50
PH
    5.40
            6.49
                   7.40
                           8.00
                                                           2.93
                                                                  3.45
                                                                           4.10
                                   1.89
                                           2.24
                                                   2.49
PH
     4
   4.85
            5.79
                   6.55
                           7.10
PH
                                                                  2.92
                                                                          3.45
                                           1.88
                                                   2.09
                                                           2.48
                                   1.59
PH
    10
            4.90
                   5.55
                           6.00
PН
   4.08
                                                   1.70
                                                           2.00
                                                                  2.39
                                                                          2.82
                                   1.28
                                           1.52
PH
     20
PН
   3.35
            4.00
                   4.59
                           5.00
                                                                  1.86
                                                                          2.20
                                   0.99
                                                   1.31
                                                           1.58
PH
    50
                                           1.19
                           3.83
   2.61
ÞН
            3.09
                   3.52
                                                                          1.91
                                   0.82
                                           1.01
                                                   1.16
                                                           1.37
                                                                  1.61
PH
    99
PΗ
   2.27
            2.69
                   3.02
                           3.17
KK
   RNF9
    Local Drainage to Roseau River Flowage
ΚM
                      0
KΟ
      0
             0
BA 40.81
LS
             58
                      0
    0
UC 35.53
           82.78
* fan
                                   0.65
                                              1
UA
      0
            0.05
                   0.15
                           0.35
KK RSV9
KM
    Roseau River Flowage Impoundment
       Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KM
KO
      0
              0
                     0
                             0
                                     22
RS
     1
            STOR
                    240
* rsv9stor
                                    643
                                            940
                                                   1092
                                                           1245
                                                                  1550
SV 240
            310
                    400
                            500
* rsv9flow
                            288
                                    435
                                            800
                                                   1225
                                                           1913
                                                                  3663
SQ 0
             52
                    155
* Rsv9elev
SE 1230 1230.5
                   1231 1231.5
                                   1232
                                           1233 1233.5
                                                          1234
                                                                  1235
KK RCH9
KM
    North Branch Downstream of Roseau River Flowage
                    0
                          0
ко
      0
            0
                                     22
RS
      1
           FLOW
                      0
                              0
                          11200 0.0004
                                              0
RC 0.125
           0.035
                  0.125
* rch9
                                                    900
                                                           2800
                                           786
                    750
                            756
                                    780
RX
     0
            700
                                           1224
                                                   1225
                                                           1230
RY 1230
           1225
                   1224
                           1218
                                   1218
KK RNF15
KM local drainage to DNR dam 3 Non-functional
KO
      0
              0
                      0
                             0
                                     22
BA 13.69
LS
      0
             50
                      0
UC 25.65
            51.3
* diamond
UA
   0
            0.09
                   0.34
                           0.64
                                    0.9
                                              1
KK ADH15
KO
    0
              0
                      0
                              0
                                     22
HC
      2
KK RCH15
KM
      North Branch Downstream of DNR dam 3
ко
       0
             0
                     0
                              0
                                     22
                              0
RS
      2
           FLOW
                      0
RC 0.125
           0.035 0.125
                         12800 0.0004
                                              0
* rch15
```

```
1006
RX 0
         820
               1000
                             1030
                                    1036
                                           1400
RY 1225
         1220
                1219
                       1213
                             1213
                                    1219
                                          1220
                                                 1225
KK RNF19
KM Local Drainage to DNR dam 4 Non-functional
        0 0
                     0
KO 0
BA 5.8
LS
   0
           56
                  0
UC 14.88
         29.76
* diamond
                       0.64
                              0.9
                                       1
UA 0
          0.09
                0.34
KK ADH19
          0
KO 0
HC 2
                 0
                         0
                               22
KKRCH19a
KM North Branch downstream of DNR dam 4
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 9400 0.0011
* rch19a
                              720
                                    726
                                           990
                                                  1690
RX 0
          510
                690
                      696
                     1203
                            1203
RY 1225
         1220
                1209
                                    1209
                                           1220
                                                 1225
KK RC19b
KM North Branch downstream of DNR dam 4
KO 0 0 0 0 0 22
RS 2 FLOW 0 0
RS
               0.125 26000 0.0012
RC 0.125
         0.035
* rch19b
          200
                                    324
                                           390
                                                  450
RX 0
                280
                      286
                             318
               1195 1188.5 1188.5
         1200
                                    1195
                                           1200
                                                  1210
RY 1210
KK RNF25
KM Local drainage to North Branch at Hanson Creek KO 0 0 0 0 22
BA 12.52
          43
LS 0
                  0
UC 18.8
        37.6
* rectangle
UA 0
          0.2
               0.4
                       0.6
                              0.8
KK ADH25
KM North Branch Upstream of Hanson Creek
KO 0 0 0 0
HC 2
KK RNF29
KM DNR dam 1 on Hanson Creek KO 0 0 0 0
                     0
                               22
BA 12.73
         58
LS 0
                  0
UC 34.28 79.87
* fan
                     0.35
                             0.65
UA 0
         0.05
               0.15
KK RSV29
KM DNR dam 1 on Hanson Creek
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO 0 0 0 0 0 RS 1 STOR 320 0
                             22
* rsv29stor
SV 320 370
               450 650
                              670
                                     810
                                          960
                                                 1360
* rsv29flow
SQ 0 57.5
                 166
                       319
                              558
                                     934
                                           1310
                                                  4235
* rsv29elev
               1220 1220.5
                            1221 1221.5
                                          1222
                                                  1223
SE 1219 1219.5
KK RCH29
KM Hanson Creek downstream of DNR dam 1
KO 0 0
RS 2 FLOW
               0 0
                               22
RC 0.125 0.035 0.125 6000 0.0009
```

```
* rch29
                                         1100
                                               1480
RX 0
         400
               800
                     803
                            818
                                  821
RY 1220
              1214
                    1211
                                 1214
                                         1215
                                              1220
        1215
                            1211
KM Non-functional DNR dam 2 on Hanson Creek
KO 0
BA 4.9
LS 0
        0
                     0
              0
          46
                 0
UC 22.66
         52.8
* diamond
UA 0
         0.09
                0.34
                      0.64
                             0.9
KK ADH35
                 0
                      0
                              22
KO 0
HC 2
KK RCH35
KM Hanson Creek from DNR dam 2 to Winner Dam
KO 0 0 0 0 0 RS 5 FLOW 0 0
              0.125 17000 0.0006
RC 0.125 0.035
* rch35
         110
               310
                     316
                                  342
                                         600
                                               1000
RX 0
                             336
RY 1210
                                 1204
                                         1205
                                               1210
        1205
              1204
                    1198
                           1198
KK RNF39
KM Local drainage to Winner Dam KO 0 0 0 0 0
                              22
BA 13.36
LS 0 46
UC 40.79 95.04
                 0
* diamond
UA 0
         0.09
                0.34
                      0.64
                             0.9
KK ADH39
         0
KO 0
                0
                       0
                              22
HC
     2
KK RSV39
KM Winner Dam impoundment on Hanson Creek
* rsv39stor
SV 5
                30
                                                470
                                                     580
          21
                      65
                             120
                                   220
                                          370
75
                             170
                                   320
                                          560
                                                920
                                                      1500
                32
* rsv39elev
SE1201.5 1202
              1203
                    1204
                            1205
                                   1206
                                         1207 1207.5
                                                      1208
KK RCH39
KM Hanson Creek Winner dam to North Branch KO 0 0 0 0 22 RS 1 FLOW 0 0
RC 0.125 0.035
              0.125
                    20500 0.0013
* rch39
RX 0
         700
                990
                     996
                            1036
                                   1042
                                         1290
                                               1680
                                         1200
                                               1205
RY 1205 1200
              1194
                    1182
                            1182
                                   1194
KK RNF45
KM Local drainage to outlet of Hanson Creek
KO 0 0
                 0
BA 5.59
LS 0
          38
                  0
UC 16.96 33.92
* rectangle
UA 0
          0.2
                0.4
                       0.6
                             0.8
KK ADH45
KM Hanson Creek outflow
KO 0 0 0
HC 2
                       0
                              22
KK ADH46
```

```
0
KO
        0 0 0 22
HC
KK RCH46
KM North Branch from Hanson Creek to Hayes Lake
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
               0.125 11000 0.0007
RC 0.125 0.035
* rch46
                                            460
                                                   990
RX 0
         -200
               350
                      358 390
                                     398
        1175
               1169
                      1161 1161
                                     1169
                                            1175
                                                   1190
RY 1190
KK RNF49
KM Local drainage to Hayes Lake KO 0 0 0 0 0
BA 18.29
                 0
LS 0
          45
UC 60.89 121.78
* diamond
UA 0
          0.09
                 0.34
                       0.64
                               0.9
                                   1.
KK ADH49
KO 0
HC 2
          0
                0
                     0
                                22
KK RSV49
KM Hayes Lake Dam
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO 0 0 0 0 22
RS 1 STOR 1640 0
* rsv49stor
                     1290
3070
SV 0 180
SV 2510 2760
                                            1750
                                                                2270
                              1640
                                     1680
                                                   1840
          180
                 595
                             3180
                3000
                                     3250
* rsv49flow
SQ 0 0
                0
                       0
                               0
                                     19
                                            72
                                                          640
                                                                1235
                                                   213
SQ 2000 2950
                4060
                      4610
                             5140
                                     8150
* rsv49elev
                     1165 1167 1167.2 1167.5
                                                  1168
                                                                1170
                1160
SE 1150 1155
SE 1171
        1172
               1173 1173.4 1173.7
KK RCH49
KM North Branch Hayes Lake to Beaver KO 0 0 0 0 0 0 22 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 28200 0.001
* rch49
         90
                              228
                                      236
                                            690
RX 0
                       168
                160
RY 1150 1135 1130
                     1122 1122
                                     1130
                                           1135
                                                   1150
KK RNF59
KM Local Drainage to Beaver
KO 0 0 0
                               22
BA 15.71
LS 0
          47
                   Ω
UC 43.26 64.89
* fan
UA 0
        0.05
                0.15
                       0.35
                              0.65
KK ADH59
          0
KO 0
                 0
                        0
HC
     2
KK RCH59
KM North Branch to Pencer
KO 0 0 0 0
RS 2 FLOW 0 0
                               22
RC 0.125 0.035 0.125 38000 0.0009
* rch59
                            1068
                                                  1770
                                     1072
                                           1690
RX 0
          110 1000
                       1008
RY 1125
         1120
               1115
                       1107
                              1107
                                     1115
                                            1120
KK RNF65
KM Local drainage to Pencer East
KO 0 0 0
                              22
```

```
BA 12.79
        49
LS 0
UC 15.54 12.43
* fan
                           0.65
                      0.35
UA 0
         0.05
                0.15
KK ADH65
KO 0
HC 2
          0
                0
                       0
                              22
HC
KK RCH65
KM North Branch to Severson Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 25509 0.0008
* rch65
                                    350
                                         1580
                                                1680
                      270
                             330
               250
RX 0
         80
                                        1090
                                                1095
RY 1095
        1090
              1085
                     1075
                           1075
                                   1085
KK RNF69
KM Local drainage to North Branch at Severson Creek
KO 0 0 0
                    0
                           22
BA 2.29
LS 0
          54
                 0
UC 7.24 7.24
* rectangle
UA 0 0.2
                             0.8
                0.4
                       0.6
KK ADH69
          0
                              22
KO 0
                 0
HC 2.
KKRNF070
KM Severson Creek
KO 0 0
                              22
BA 22.25
LS 0
                  0
          50
UC 17.3
         17.3
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
                                     1
KK ADH70
          0
KO 0
HC 2
                0
                       0
                              22
KKRCH070
KM North Branch to Bear Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
                              22
RC 0.125 0.035 0.125 29973 0.0008
* rch70
                                               1680
              250 270
                                         1580
                                   350
                             330
RY 1085
        1080
              1075 1065
                            1065
                                   1075
                                         1080
                                               1085
KKRNF079
KM Local drainage North Branch at Bear Creek KO 0 0 0 0 22
BA 7.52
        52
LS 0
UC 13.14 13.14
* rectangle
                       0.6
                              0.8
UA 0
          0.2
              0.4
KK ADH79
KO 0 0
HC 2
                0
                       0
                              22
KK RNF80
KM Local Drainage Comstocks Bear Creek at Roseau CSAH 9 KO 0 0 0 22
BA 20.66
LS 0
         55
                0
UC 16.8
        14.11
* fan
                            0.65 1
UA 0
              0.15 0.35
         0.05
```

```
KK RCH80
KM Bear Creek Comstock to North Branch
KO 0 0 0 0 22
RS 3 FLOW 0 0
        0.035
              0.125 28200 0.0008
RC 0.125
* rch80
          180 400
                             456
                                          640
RX 0
                      406
                                   462
                                                820
RY 1080
        1075 1070 1064
                           1064
                                   1070
                                         1075
KK RNF85
KM Local drainage Bear Creek at outlet KO 0 0 0 0 22
    0 0 0 0
BA 5.27
         54
LS 0
UC 11.08 8.64
* rectangle
        0.2
              0.4
                                   1
UA 0
                      0.6
                             0.8
KK ADH85
KM Bear Creek at North Branch
KO 0
HC 2
KO
        0 0
                              22
KK ADH86
KO 0
HC 2
                0
                              22
KK RCH86
KM North Branch from Bear Creek to Malung
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 20800 0.0006
* rch86
RX 0
        260
              350
                     354
                                   415
                                         490
                             411
RY 1070
        1055
              1054
                    1050
                            1050
                                  1054
                                         1055
                                               1070
KK RNF99
KM Local Drainage to Gage 2
KO 0 0 0
BA 2.18
LS 0
         57 . 0
UC 3.96
         2.65
* diamond
UA 0
         0.09
              0.34
                      0.64
                             0.9
                                     1
KK ADH99
          0 0
KO 0
HC 2
                       0
                              22
KKRSV99
KM temporary calibration reservoir
RS 1 STOR 0
* rsv99stor
                                                      7800
                                                            8000
SV 0 800
              1200 4800
                            6500
                                   7000
                                         7300
                                               7400
* rsv99flow
              200
G2
SQ 0 100
                      500
                            1000
                                   1500
                                         2500
                                               3000
                                                      5000 15000
KK RCH99 CNAME
KM North Branch gage 2 to South Branch
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 17800 0.0004
* rch99
                                         260
RX 0 110 180 186
                           246
                                   252
                                                810
              1044
                                         1050
                                               1055
RY 1055 1050
                    1038
                           1038
                                  1044
KKRNF109
KM Local drainage South Branch at Skime KO 0 0 0 0 22
BA 28.21
        55
LS 0
UC 67.63 157.58
* fan
UA 0 0.05 0.15 0.35
                            0.65
```

```
KKRCH109
KM South Branch Skime to Casperson
KO 0 0 0 0 22
RS 2 FLOW 0 0
        0.035 0.125 34800 0.0007
RC 0.125
* rch109
         1400 1620 1624 1664
1170 1165 1161 1161
                                          2150
                                   1668
RX 0
RY 1175
                                   1165
                                          1170
                                                1175
KKRCH110
KM South Branch Casperson to Mickinock Creek
KO 0 0 0 0 0 RS 3 FLOW 0 0
        0.035 0.125 35000 0.0012
RC 0.125
* rch110
                                          400
                                                540
RX 0
         280
              300 305
                            345
                                   349
RY 1135 1130 1125 1120 1120
                                   1125
                                         1130
                                                1135
KKRNF119
KM Local drainage to South Branch at Mickinock Creek
KO 0 0 0
BA 24.2
LS 0 56
UC 25.87 51.74
        56
                0
rectangle
UA 0 0.2
                                    1
              0.4
                       0.6
                           0.8
KKADH119
KM Combined flow South Branch upstream of Mickinock Creek
    0 0 0 0 22
KO
HC 2
KKRNF120
KM Palmville sub RNF3
KM Palmville sub refers to areas developed for the Palmville Flood Control P
KO 0 0 0
                       0
                              22
BA 1.27
LS 0
          60
UC 7.06 14.12
* fan
UA 0
                      0.35
                              65
         0.05
              0.15
KKRCH120
         0
                0
KO 0
RS 1
                       0
                              22
         FLOW
                        0
RC 0.15
         0.15
               0.15
                      5500 0.0018
* rch120
          10 20
                             800
                                  1300
                                          1310
                                                1320
RX 0
                    500
                                         1169
                                                1170
                            1168 1168.5
RY 1170
         1169 1168.5
                      1168
KKRNF121
22
BA 0.95
LS 0
          63
                 0
UC 9.62
        19.24
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
KKRCH121
         0
KO 0
RS 1
                0
                       0
                              22
         FLOW
                        0
RC 0.15
         0.15
                0.15
                      5500 0.0009
* rch121
           10
               20
                       500
                              800
                                  1300
                                          1310
                                                1320
RX 0
RY 1172
         1171 1170.5
                                         1171
                                                1172
                      1170
                             1170 1170.5
KKRNF123
KM Palmville sub RNF4a
KO 0 0 0
                       0
                             22
BA 2.32
LS 0
         62
UC 6.98 13.96
```

* f	an										
UA	0	0.05	0.15	0.35	0.65	1					
KKA	ADH123										
KO	0	0	0	0	22						
HC	2										
KKF	RCH123										
KO	0	0	0	0	22						
RS	1	FLOW	0	0							
RC	0.15	0.15	0.15	2500	0.004	0					
*	rch120										
	0	10					1310				
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170			
	ADH124										
KO	0	0	0	0	22						
HC 2											
	NF125										
KM			sub RNF5								
KO	0	0	0	0	22						
BA	4.44										
LS	0	54	0								
	15.4	30.8									
* f	an										
UA		0.05	0.15	0.35	0.65	1					
	RCH125										
	0	0		0	22						
	1	FLOW		0		•					
	0.15	0.15	0.15	1500	0.0033	0					
	rch120						1210	1220			
RX	0		20 1168.5				1310				
		1169	1168.5	1168	1168	1168.5	1163	1170			
	RNF126										
			sub RNF6	0	22						
	0	0	0	U	44						
	1.25 0	57	0								
	11.52		J								
	an	17.20									
	.a 0	0.05	0.15	0.35	0.65	1					
	CH126	0.05	0.15	. 0.33	0.05	-					
	0	0	0	0	22						
	1	WO.IT	0	0							
	0.15		0.15			0					
	rch120	4.45		• • • • • • • • • • • • • • • • • • • •							
	0	10	20	500	800	1300	1310	1320			
RY		1169	1168.5	1168	1168	1168.5	1169	1170			
	NF127										
KM	Pal	.mville	sub RNF7								
ко	0	0	0	0	22						
	2.93										
LS	0	48	0								
UC	16.27	16.27									
* 0	liamond										
UA	0	0.09	0.34	0.64	0.9	1					
KKF	RCH127										
KO	0	0	0	0							
RS	1	FLOW	0	0							
		0.15	0.15	9000	0.0006	0					
	rchl20										
	0		20								
		1169	1168.5	1168	1168	1168.5	1169	1170			
KKRNF128											
KM	Pal	mville	sub RNF8 0	_							
KO		0	0	0	22						
BA			•								
LS	0	47	0								

.

**** 6 25	0 20						
UC 6.25	9.38						
* fan							
UA 0	0.05	0.15	0.35	0.65	1		
KKRCH128							
KO 0	0	0	0	22			
RS 1	FLOW	0	0				
RC 0.15	0.15	0.15	6000	0.0008	0		
* rch120							
RX 0	10	20	500	800	1300	1310	1320
RY 1170	1169	1168.5	1168	1168	1168.5	1169	1170
KKRNF129							
KM Pa	lmville	sub RNF9					
KO 0	0	0	0	. 22			
BA 2.9							
LS 0	47	0					
		U					
UC 7.84	11.76						
* fan							
UA 0	0.05	0.15	0.35	0.65	1		
KKRNF130							
KM Pa	lmville	sub RNF1	0				
KO 0	0	0	0	22			
	J	•	ŭ				
BA 1.29		•					
LS 0	45	0					
UC 5.11	11.91						
* fan							
UA 0	0.05	0.15	0.35	0.65	1		
KKADH130							
KO 0	0	0	0	22			
HC 7	•	•	•				
KKRNF131			_				
KM Pa	lmville	wildlife	pool				
KO 0	0	0	0	22			
BA 7.65							
LS 0	62	0					
UC 13.89							
* fan	30.30						
			0.35	0.65	1		
	0.05	0.15	0.35	0.65	1		
KKADH131							
KO 0	0	0	0	22			
HC 2							
KKRNF132							
KM Pa	Lmville	Flood Po	ol				
KO 0	0		0	22			
BA 0.89	•	-	_				
	-						
LS 0	62	0					
	18.29						
* diamond							
UA 0	0.09	0.34	0.64	0.9	1		
KKADH132							
KO 0	0	0	0	22			
HC 2							
KKRCH132	_	_					
KO 0	0			22			
DC 1	ET OM	0	0				
RS 1	FLOW				^		
RC 0.15		0.15	10560	0.0005	U		
RC 0.15 * rch132			10560	0.0005	U		
RC 0.15 * rch132	0.05	0.15				1320	1325
RC 0.15 * rch132 RX 0	0.05	0.15	16	24	34		
RC 0.15 * rch132 RX 0 RY 1153	0.05	0.15	16	24	34		
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133	0.05 4 1151	0.15 6 1149	16 1144	24 1144	34		
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133	0.05 4 1151	0.15 . 6 1149	16 1144 0	24 1144 22	34		1152
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133 KO 0 RS 1	0.05 4 1151 0 FLOW	0.15 6 1149 0	16 1144 0 0	24 1144 22	34 1149		1152
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133	0.05 4 1151 0 FLOW	0.15 6 1149 0	16 1144 0 0	24 1144 22	34 1149		1152
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133 KO 0 RS 1	0.05 4 1151 0 FLOW 0.05	0.15 	16 1144 0 0	24 1144 22	34 1149		1152
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133 KO 0 RS 1 RC 0.15	0.05 4 1151 0 FLOW 0.05	0.15 	16 1144 0 0 9200	24 1144 22 0.0016	34 1149 0	1150	1152
RC 0.15 * rch132 RX 0 RY 1153 KKRCH133 KO 0 RS 1 RC 0.15 * rch133	0.05 4 1151 0 FLOW 0.05	0.15 · 6 1149 0 0 0.15	16 1144 0 0 9200	24 1144 22 0.0016	34 1149 0	1320	1152

```
KKRNF139
KM Local drainage to Oseland Gage KO 0 0 0 0 22
BA 23.74
LS 0
           56
                    0
UC 21.3 31.95
* fan
UA 0
                          0.35
                                 0.65
           0.05
                   0.15
KKADH139
KO 0
            0
                    0
                             0
                                   22
HC
     2
KKRCH139
KO 0
RS 1
            0
                    0
                          0
                   0
           FLOW
                            0
           0.05
                         14800 0.0006
RC 0.125
                 0.125
* rch139
                                                 305
                                                         350
RX 0
            140
                   200
                          204
                                  224
                                          228
RY 1127 1120
                 1119
                          1115
                               1115
                                         1119
                                                1120
                                                        1127
KKRNF145
KM Local drainage to Mickinock Creek at Outlet KO 0 0 0 0 22
BA 8.37
           54
LS 0
                    0
UC 18.97 18.97
* fan
                          0.35
                                  0.65
UA 0
          0.05
                 0.15
KKADH145
KM Mickinock Creek
KO 0 0
HC 2
                                   22
                     0
                             0
KKADH146
            0
                   0
                             0
                                   22
KO 0
HC
      2
KKRCH146
KM South Branch Mickinock Creek to Wannaska
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 26600 0.0009 0
* rch146
RX 0
           90
                                  167
                                         174
                                                 305
                                                         390
                   120
                          127
                 1100
RY 1110
                                1093
                                                1105
                                                        1110
          1105
                         1093
                                         1100
KKRNF149
KM Local drainage South Branch at Wannaska
    0 0 0 0 22
KO
BA 14
LS 0
           54
                     0
UC 19.28 19.28
* fan
UA 0
          0.05
                  0.15
                          0.35
                                  0.65
KKADH149
           0
                    0
KO 0
                           0
                                   22
HC
     2
KKRCH149

        KM
        South Branch Wannaska to Paulson Creek

        KO
        0
        0
        0
        22

        RS
        1
        FLOW
        0
        0
        0

RC 0.125 0.035 0.125 15200 0.0004
* rch149
           175
                  300
                        306
                                 346
                                         352
                                                 775
RX 0
RY 1100 1095
                 1090
                        1084
                               1084
                                         1090
                                                1095
                                                        1100
KKRNF155
KM Local drainage South Branch at Paulson Creek KO 0 0 0 0 22
BA 4.45
    0
LS
           53
                     0
```

```
UC 6.05
           4.05
* fan
UA 0
                  0.15
                        0.35
                                 0.65
                                         1
           0.05
KKADH155
                    0
                             0
                                   22
KO 0
            0
HC
     2
KKRNF159
KM Local drainage gage 43 Roseau CD 21 at CSAH4
KO 0 0 0
                             0
                                22
BA 20.07
LS 0
           55
UC 20.56
          27.76
* fan
UA 0
           0.05
                  0.15
                          0.35
                                 0.65
KKRCH159
                   0
KO 0
RS 1
            0
                             0
RS
           FLOW
                            0
RC 0.125
           0.05
                 0.125
                          8500 0.0005
* rch159
RX 0
           7.5
                   15
                           30
                                  38
                                         53
                                               1373
                                                        2700
RY 1125 1122.5
                  1120
                          1115
                                 1115
                                         1120 1122.5
                                                        1125
KKRCH160
                  0
0
KO 0
            0
                             0
                                   22
RS
     1
          FLOW
                            0
RC 0.125
           0.05 0.125
                          4400 0.0036
                                          0
* rch160
                                         200
                                                300
RX 0
           150
                  180
                          185
                                  195
                                                        400
           1100
                          1090
                                 1090
                                         1095
                                                1100
                                                        1115
RY 1115
                 1095
KKRNF165
KM Local Drainage Paulson Creek at Outlet KO 0 0 0 0 22
BA 3.47
LS 0
           53
UC 10.25 10.25
* fan
UA 0
          0.05
                 0.15
                        0.35
                                            1
                                 0.65
KKADH165
KM Combined outflow Paulson Creek
KO 0
HC 2
          0
                    0
                            0
KKADH166
            0
                   0
                          0
                                   22
KO 0
HC 2
KKRCH166

        KM
        South Branch Paulson Creek to Pencer West

        KO
        0
        0
        0
        22

        RS
        2
        FLOW
        0
        0
        0

RC 0.125 0.035 0.125 29800 0.0004
                                          0
* rch166
                          520
                                         600
                                                 650
                                                        700
RX 0
           160
                  500
                                  580
RY 1090
                                 1070
                                         1080
                                                1085
         1080
                 1080
                        1070
KKRNF169
KM Local Drainage to Pencer West KO 0 0 0 0 0 0
         0
                 0
                                   22
BA 6.56
LS 0
           61
                     0
UC 14.79 14.79
* fan
UA 0
           0.05
                  0.15
                          0.35
                                 0.65
KKADH169
KO 0
            0
                    0
                           0
                                   22
HC
     2
KKRCH169
KM South Branch Pencer West to Unamed Creek 1
         0 0
                         0
```

```
RS 1 FLOW
               0 0
RC 0.125 0.035 0.125 17000 0.0005
* rch169
          90
              690
RX 0
                      712
                              752
                                    774
                                          800
RY 1075 1070
              1065
                     1054
                             1054
                                    1065 1070
                                                 1075
KKRNF170
{
m KM} Local draiange South Branch at Unamed Creek 1
                       0
KO
    0
         0
                 0
BA 1.65
LS 0
         61
                 0
UC 6.34
         6.34
* general
              0.36 0.67
UA 0
                             0.89
          0.13
KKADH170
KM South Branch upstream Unamed Creek 1
KO 0 0 0 0 0 HC 2
KKRNF171
KM Local Drainage Unamed Creek 1
KO 0 0 0 0
BA 13.67
         54
LS 0
UC 19.15 19.15
* fan
         0.05
               0.15
                             0.65
UA 0
                      0.35
KKADH171
        0
KO 0
HC 2
                 0 . 0
KKRCH171
KM South Branch Unamed Creek 1 to Unamed Creek 2
KO 0 0 0 0 22
RS 3 FLOW 0 0
RC 0.125 0.035
              0.125 34400 0.0005
* rch171
                      712
                              752
                                    774
          90
                690
RX 0
                                                 1070
RY 1070 1065 1060
                                   1060 1065
                    1049
                             1049
KKRNF172
KM Local drainage South Branch at Unamed Creek 2 KO 0 0 0 0 22
BA 5.04
LS 0
          60
UC 16.23 16.23
* diamond
UA 0
        0.09
              0.34
                      0.64
                              0.9
KKADH172
KM South Branch upstream Unamed Creek 2 KO 0 0 0 0 22 HC 2
KKRNF173
KM Local drainage Unamed Creek 2 KO 0 0 0 0 0
BA 16.03
LS 0 53
UC 16.17 16.17
                 0
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
KKADH173
KO 0
HC 2
          0
                 0
                       0
KKRCH173
KM South Branch Unamed Creek 2 to Gage 1
KO 0 0 0 0 0 RS 3 FLOW 0 0
         FLOW
RC 0.125 0.035 0.125 27000 0.0005
* rch173
```

```
RX 0 90
                                   774
                     712
                            752
                                          800
                                                850
               690
RY 1065
        1060
                            1044
                                   1055
                                         1060
                                                1065
               1055
                      1044
KKRNF199
KM Local drainage to Gage 1
KO
    0 0 0
                              22
BA 9.25
LS 0
         57
                  0
UC 11.09 11.09
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
KKADH198
                  0
                              22
KO 0
HC 2
KKRNF180
KM Local drainage gage 3 Sec 18/19 T161N R39W
KO 0 0 0 0 22
BA 11.52
        54
                0
LS 0
UC 18.81 18.81
* fan
UA 0
        0.05
              0.15
                     0.35 0.65
KKRCH180
KM Sucker Creek Gage 1 to Outlet
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125
         0.05 0.125
                      9000 0.0023
* rch180
          90
RX 0
                100
                      125
                             130
                                   155
                                          180
                                                240
RY 1060
                                   1044
                                         1050
                                                1060
         1050
               1044
                      1041
                           1041
KKRNF189
KM Local drainage outlet Sucker Creek
KO
    0 0 0
                     0
BA 0.69
LS 0
         55
UC 7.44 4.98
* rectangle
UA 0
                                    1
          0.2
               0.4
                       0.6
                             0.8
KM Sucker Creek Outflow
KO 0
HC 2
        0
                        0
                              22
KKADH199
KO 0
HC 2
          0
                0
                        0
                              22
HC
KKRSV199
KM temporary calibration reservoir
RS 1 STOR 0
* rsv199stor
SV 0 800
                                                      7800
                                                             8000
                      4800
                                   7000
                                         7300
                                                7400
               1200
                            6500
* rsv199flow
SQ 0 100
                                   1500
                                         2500
                                                3000
                                                      5000
                                                            15000
               200
                     500
                            1000
KKRCH199
KM South Branch to North Branch
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035
              0.125
                     6000 0.0005
* rch199
          90
                100
                             146
                                   152
                                          290
                                                1200
RX 0
                      106
RY 1055
       1040
               1039
                      1033
                            1033
                                   1039
                                         1050
                                                1055
KKADH200
KO 0
HC 2
          0
               0
                       0
HC
KKRCH200
KM Roseau River to USGS Gage near Malung
   0
KO
        0 0 0 22
```

```
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 2400 0.0003
* rch200
                                         600
                                                1600
        400
              435
                    443
                            493
                                   501
RX 0
                                  1040
                    1034 1034
                                         1050
                                                1055
RY 1055 1045 1040
KKRNF209
KM Local drainage to USGS Gage near Malung Gage 50 KO 0 0 0 0 22
BA 3.24
LS 0
         55
                 0
UC 8.83
         8.83
* fan
UA 0
         0.05
                0.15
                      0.35
                             0.65
                                    1
KKADH209
          0
                 0
                       0
                              22
KO 0
HC
     2
KKRCH209
KM Roseau River gage 50 to CD 8
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 1000 0.0003
* rch200
        400
              435 443
1040 1034
                             493
                                    501
                                          600
                                                1600
RX 0
RY 1055
        1045
              1040
                           1034
                                   1040
                                         1050
                                                1055
KKRNF211
KM Local Drainage to Stafford area 1 KO 0 0 0 0 22
BA 11.25
        52
LS 0
                  0
UC 16.8 11.25
* fan
        0.05 0.15 0.35 0.65
UA 0
KKRNF212
KM Local drainage to Stafford area 2
                      0 22
KO 0 0 0
BA 1.45
         53
LS 0
UC 2.49
        1.67
* fan
              0.15
                    0.35
                           0.65
UA 0
         0.05
KKRNF213
KM Local drainage to Stafford area 3
                     0 22
KO 0 0 0
BA 0.7
LS 0
         47
                  0
UC 5.56
        3.73
* fan
UA 0
         0.05
              0.15
                     0.35
                           0.65
KKADH211
          0
KO 0
                 0
                       0
                             22
HC 3
KKRCH211
KM Roseau County Ditch 8 Stafford project to Outlet KO 0 0 0 0 22 RS 1 FLOW 0 0
        0.05 0.125 17120 0.0005
RC 0.125
                                    0
* rch211
               16
                      31
                                    52 1372 2640
          10
                             37
RX 0
RY1058.2 1058 1056 1051 1051
                                  1056 1056.2 1056.5
KKRNF219
KM Local Drainage Outlet RCD 8
KO 0 0 0 0
                             22
BA 6.26
LS 0
UC 17.92 17.92
```

```
* fan
UA 0
        0.05 0.15 0.35 0.65
KKADH220
KM Roseau County ditch 8 outflow
KO 0
HC 2
        0 0 0
KKADH221
           0 0 0
KO 0
                               22
HC
     2
KKRCH221
KM Roseau River RCD 8 to Cow Creek
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 8800 0.0003
* rch221
RX 0 3600 3800 3812 3862
                                     3874
                                           4024
                                                  7624
RY 1055 1050
               1035
                     1029 1029
                                     1035
                                           1050
                                                  1055
KKRNF229
KM Local drainage Roseau River at Cow Creek KO 0 0 0 0 22
BA 4.83
          53
                 0
LS 0
UC 12.04 12.04
* fan
        0.05 0.15 0.35 0.65
UA 0
KKADH229

        KM
        Roseau River upstream Cow Creek

        KO
        0
        0
        0
        22

        HC
        2

KKRNF248
KM Local drainage Cow Creek Gage 44 Sec 31/32 T162N R39W
KO
    0 0 0 0 22
BA 16.9
         55
               0
LS 0
UC 15.15 15.15
* fan
UA 0
               0.15
                     0.35
        0.05
                            0.65
KKRCH248
KM Cow Creek Gage 44 to Outlet
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.05 0.125 4800 0.0023
* rch248
               190
                      194
                                     208
                                           290
                                                  380
RX 0
          170
                              204
RY 1050
        1045
               1044
                     1040
                            1040
                                    1044
                                           1045
KKRNF249
KM Local drainage outlet Cow Creek
KO
    0 0 0 0 22
BA 0.31
LS 0
          58
UC 1.76 1.76
* rectangle
UA 0
               0.4
          0.2
                        0.6
                              0.8
KKADH249
KM Cow Creek Outflow
KO 0 0 0
HC 2
                               22
KKADH260
          0 0 0
KO 0
                               22
HC
     2
KKRCH260
KM Roseau River Cow Creek to Center Street
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 11800 0.0003
```

```
* rch221
                                          4024
                                                7624
RX 0
               3800
                     3812 3862
                                   3874
         3600
RY 1055 1050
              1035 1029 1029 1035
                                          1050 1055
KKRNF269
KM Local drainage Roseau River at Center Street
KO
    0 0
               0
                       0
                             22
BA 5.07
        60
LS 0
UC 10.04 10.04
* fan
UA 0
         0.05
                0.15
                       0.35
                            0.65
KKADH269
                  0
                       0
                             22
KO 0
HC 2
KKRCH269
KM Roseau River Center Street to Gage 15
KO 0 0 0 0 0 22
RS 2 FLOW 0 0
RC 0.125 0.035 0.125 23500 0.0003
* rch269
RX 11097 13712 20000 20035 20106 20131 20219 23721
RY1043.9 1038.4 1041.3 1024.7 1024.7 1036.8 1035.1 1043.6
KKRNF299
KM Local drainage Roseau River Gage 15 KO 0 0 0 0 22
    0 0 0 0 22
BA 5.51
          60
                 0
LS 0
UC 9.18
         9.18
* diamond
UA 0
         0.09
                0.34
                       0.64
                              0.9
KKADH299
KO 0
HC 2
          0
                 0
                       0
                               22
KKRNF319
KM Local Drainage Hay Creek at County Road 2 Sec 1/12 T161N R37W KO 0 0 0 22
BA 19.38
          57
LS 0
UC 17.12 16.95
* fan
         0.05 0.15 0.35 0.65 1
UA 0
KKRCH319
KM Hay Creek County Road 2 to Branch CD 9
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125
         0.05 0.125 7200 0.0017
* rch319
                      1282 1300
1089 1089
              1270
1095
                    125.
1089
                                    1312
                                          1400
                                                 1650
RX 0
         1130
RY 1110
                                               1110
         1105
                                    1095
                                          1105
KKRNF335
KM Upper Summer Road RCD 9 drainage
KO 0 0 0 0 0 22
BA 10.04
        51
LS 0
                  0
UC 19.28 19.28
* fan
        0.05
              0.15
                     0.35
                           0.65
UA 0
KKDVT335
KM Split flow west to Summer Road
DTOUT335
          0
                0
* din335
DI 0
           50
                 100
                       200
                              300
                                    500
                                           750
                                                 1000
* dout335
                     133
DO 0
           33
              67
                              200
                                    333
                                           500
                                                  670
KKRCH335
```

```
KM Branch of RCD 9 west to Hay Creek
KO 0
RS 1
                 0 0
            0
            FLOW
RC 0.125
                           8810 0.0005
            0.05
                 0.125
* rch335
                           1708
                                   1712
                                           1720
                                                   1722
                                                           1724
RX 0
            800
                   1700
RY 1110
            1107
                   1105
                           1101
                                   1101
                                           1105
                                                  1106
                                                           1107
KKADH336
            . 0
                    0
                             0
                                     22
KO 0
   2
HC
KKRCH336

        KM
        Hay
        Creek branch
        RCD9 to
        Summer
        Road

        KO
        0
        0
        0
        0
        22

        RS
        1
        FLOW
        0
        0
        0

                           7800 0.0017
RC 0.125
            0.05
                  0.125
* rch336
                   1270
                                           1312
                                                   1400
                                                           1650
                           1282
                                   1300
RX 0
            1130
RY 1105
           1100 1090
                         1084 1084
                                           1090
                                                  1100
                                                           1105
KKRNF339
KM Local Drainage Hay Creek at Summer Road KO 0 0 0 0 0 22
          0
BA 10.5
LS 0
             49
UC 17.2
            17.2
* fan
UA 0
            0.05
                    0.15
                            0.35
                                   0.65 . 1
KKADH339
KO 0
HC 2
              0
                      a
                             0
                                     22
KKRCH339
KM Hay Creek Summer Road to Branch of RCD 9
           0 0 0 22
FLOW 0 0
KO 0
RS 1
            0.05 0.125
                         4400 0.001
RC 0.125
* rch339
                                           3592
                                                   4000
                                                           4800
                  3550 3562
                                   3580
            100
RX 0
RY 1080
           1078
                  1075
                           1069
                                   1069
                                           1075
                                                   1078
                                                           1080
KKRNF351
KM Local drainage Upper Hwy 11
                                     22
KO 0 0 0
BA 4.32
            55
                      0
LS 0
UC 12.99
         12.99
* fan
UA 0
            0.05
                   0.15
                         0.35
                                   0.65
KKRTV335
KM Split flow from Upper Summer Road North
DROUT335
          CNAME
KKRCH350
                    0
RS 2
           FLOW
                             0
                          10560 0.0014
RC 0.125
            0.05
                  0.125
* rch350
             2
                                            24
                                                 1320
                                                           2640
RX 0
                      4
                             12
                                     16
RY 1107
                                           1105 1105.5
                                                           1107
            1106
                    1105
                           1101
                                   1101
KKADH351
KO 0
              0
                      0
                             0
                                     22
HC
     2
KKDVT351
KM Split flow to Roseau County Road 11
DTOUT351
* din351
DI O.
            100.
                    200.
                           400.
                                    600.
                                            800.
                                                  1000.
                                                          2000.
* dout351
DQ 0.
                   100.
                         200.
                                   300.
                                            400.
                                                   500.
             50.
KKRCH351
```

KM Bran	ich RCD	9 to Hay	Creek				
KO 0	0	0	0	22			
RS 3	FLOW	0	0				
RC 0.125	0.05	0.125	16600	0.0007	0		
* rch351							
RX 0	750	1320	1328	1332	1340	1342	1344
RY 1090	1089	1088	1084	1084	1088	1090	1092
KKADH352	2005	2000					
	0	0	0	22			
KO 0	0	U	. 0	22			
HC 2							
KKRCH352							
KM Hay	Creek b	ranch of	RCD9 to	Gage 12			
KO 0	0	0	0	22			
RS 1	FLOW	0	0				
RC 0.125	0.05	0.125	7400	0.0014	0		
* rch352							
RX 0	100	3550	3562	3580	3592	4000	4800
RY 1075	1073	1070	1064	1064	1070	1073	1075
KKRNF359							
	l drain	age Hav (Creek at	Gage 12			
KO 0	0	age nay (0				
	U	U	U	44			
BA 12.44							
LS 0	50	0					
UC 13.97	14.39						
* diamond		_			_		
UA 0	0.09	0.34	0.64	0.9	1		
KKADH359							
KO 0	0 .	0	0	22			
HC 2							
KKRCH359							
KM Hay	Creek G	age 12 to	Branch	RCD 9			
KO 0	0	0	0	22			
RS 1	FLOW	0	0				
RC 0.125		0.125		0.0009	0		
* rch359	0.05	V.155			_		
RX 0	250	550	562	580	592	700	1000
RY 1070	1069	1065	1059	1059	1065	1068	1070
KKRTV351	1000	1000	,2000	2000	1000	4000	
	r Hone T	l split i	Flow				
DROUT351	- 11MA T	י ידדים י	-10"				
KKRCH352	ELON.	^	0				
RS 4	FLOW		27920	0.0007	0		
RC 0.125	0.05	0.125	3/920	0.0007	U		
* rch352							
RX 0	2	4	12	16	24		1000
RY 1076	1075	1074	1070	1070	1074	1074	1075
KKADH360							
ко 0	0	0	0	22			
HC 2							
KKRCH360							
		ranch RCI	09 to MN	HWY 11			
KM Hav	Creek Ri		0	22			
-		٥		~ ~			
ко о	0	0					
KO 0 RS 1	0 FLOW	0	0	0 0000	0		
KO 0 RS 1 RC 0.125	0 FLOW	0	0	0.0009	0		
KO 0 RS 1 RC 0.125 * rch360	0 FLOW 0.05	0 0.125	0 4980				1000
KO 0 RS 1 RC 0.125 * rch360	0 FLOW 0.05	0 0.125	0 4980			700	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060	0 FLOW 0.05	0 0.125	0 4980			700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379	0 FLOW 0.05 250 1058	0 0.125 550 1055	0 4980 562 1049			700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060	0 FLOW 0.05 250 1058	0 0.125 550 1055 age MN Hv	0 4980 562 1049			700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379	0 FLOW 0.05 250 1058	0 0.125 550 1055 age MN Hv	0 4980 562 1049			700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca	0 FLOW 0.05 250 1058	0 0.125 550 1055 age MN Hv	0 4980 562 1049	580 1049		700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca KO 0 BA 20.97	0 FLOW 0.05 250 1058 1 Draina	0 0.125 550 1055 age MN Hv	0 4980 562 1049	580 1049		700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca KO 0 BA 20.97 LS 0	0 FLOW 0.05 250 1058 1 Draina 0	0 0.125 550 1055 age MN Hv	0 4980 562 1049	580 1049		700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca KO 0 BA 20.97 LS 0 UC 37.8	0 FLOW 0.05 250 1058 1 Draina	0 0.125 550 1055 age MN Hv	0 4980 562 1049	580 1049		700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca KO 0 BA 20.97 LS 0 UC 37.8 * fan	0 FLOW 0.05 250 1058 1 Draina 0 54 56.7	0 0.125 550 1055 age MN Hv 0	0 4980 562 1049 wy 11 0	580 1049 22	592 1055	700 1058	
KO 0 RS 1 RC 0.125 * rch360 RX 0 RY 1060 KKRNF379 KM Loca KO 0 BA 20.97 LS 0 UC 37.8	0 FLOW 0.05 250 1058 1 Draina 0 54 56.7	0 0.125 550 1055 age MN Hv 0	0 4980 562 1049 wy 11 0	580 1049 22	592 1055	700 1058	

```
KKADH379
KO 0 0 0 0 22
HC 2
KKRCH379
KM Hay Creek MN Hwy 11 to Hay Creek Proj Det 1
KO 0 0 0 0 22
RS 1 FLOW 0 0
        0.035 0.125
                   5680 0.0004
RC 0.125
* rch379
                                 2340
                                       4000
                                              5000
RX 0
         1000
              2300 2312
                           2328
        1058
             1058
                   1050
                                 1058
                                       1058
                                              1060
RY 1060
                           1050
KKRNF381
KM Hay Creek Proj Det 1
KO 0 0 0
                             22
BA 4.14
LS 0
         54
UC 20.23 20.23
* fan
UA 0
                           0.65
        0.05
              0.15
                     0.35
KKADH381
         0
             0
KO 0
HC 2
                      0
                             22
KKRCH381
KM Hay Creek Det 1 to Roseau County Ditch 18
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125 0.035 0.125 10820 0.0004
* rch381
              2300 2312
1053 1045
                           2328
                                 2340
                                       4000
                                              5000
RX 0
        1000
RY 1055
              1053
                          1045
                                 1053
                                      1053
        1053
KKRNF385
KM Norland sub RNF50 Roseau County Ditch 18 Sec 4/5 T162N R38W
    0 0 0 0
                          22
KO
BA 8.39
LS 0 55
UC 29.83 59.66
* rnf385
                                0.75 0.83
                                            0.89 0.94 0.98
UA 0
UA 1
             0.24 0.46 0.65
         0.1
KKRCH385
KM RCD 18 to Hay Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
                            22
RC 0.08 0.05 0.08 17690 0.001
* rch385
        5 10 45
                           53 57 100 250
RY1067.4 1067.4 1067.4 1056.14 1056.14 1064.7 1064.7 1064.7
KKRNF391
KM Hay Creek Project Pool #1 KO 0 0 0 0 0
        0 0
BA 2.21
LS 0
         55
                0
UC 3.6
         3.6
* fan
0 AU
         0.05
              0.15
                   0.35
                           0.65
KKADH391
                0
                      0
KO 0
         0
                            22
HC
    2
KKRCH391 CNAME
               391
KM RCD 18 Pool#1 to NW Sec 2 T162N R39W
KO 0 0 0 0 0 RS 1 FLOW 0 0
                   5280 0.0003
RC 0.08
        0.05
              0.08
* rch391
       5 10 24 30
                                      5000
                                              5250
RX 0
                                   44
```

```
1042
                           1042
                                  1049 1049.5
                                               1050
RY 1053 1052
              1049
KKDVT391
KM Split flow RCD 18
DTOUT391
* in391
         300.
                600.
                      900.
                           1200.
                                  2100.
DI 0.
* out391
DO 0.
         200.
                400.
                      600.
                           800.
                                  1400.
KKRCH392
KM RCD 18 NW Sec 2 T162N R39W
KO 0 0
RS 1 FLOW
              0 0
RC 0.08
         0.05
                     8300 0.0003
                0.08
* rch392
RX 0
           5
                              30
                                    44
                                         5000
                                                5250
                10
                       24
                                   1048 1048.5
RY 1052
         1051
                1048
                      1041
                             1041
                                                1049
KKADH395
KO 0
HC 2
                       0
                0
                             22
HC
KKRCH395
KM Hay Creek RCD 18 to Outlet
KO 0 0 0 0 0 RS 1 FLOW 0 0
RC 0.125
        0.035 0.125 12900 0.0004
* rch395
                                                5000
                2300
                     2312
                             2328
                                   2340
                                          4000
RX 0 1000
RY 1050 1048 1048
                     1040 1040
                                   1048
                                          1048 1050
KKRNF399
KM Local drainage to Lower Hay Creek KO 0 0 0 0 22
                     0 22
BA 19.76
          53
                0
LS 0
UC 24.8
          31
* fan
UA 0
        0.05 0.15
                      0.35
                             0.65
KKADH399
KM Hay Creek at Outlet
                       0
KO 0 0 0
HC 2
                              22
KKADH400
KM Roseau River at Gage 15 Sec 6/31 T162-163N R39W County Road 28
KO 0 0 0 0
                             22
HC 2.
KKRSV400
KM Storage behind CR 28
KO 0 0
RS 1 FLOW
                              22
               0
                       0
* rsv400stor
SV 0 147
                            2587
                                   4517
                                          7282 10872
                                                     15272 20471
                 247
                      847
* rsv400flow
SQ 0 720
                                          6120
                                                8450
                                                     10000 11690
                      2190
                             4110
                                   5200
                800
KKRTV391
KM Overflow RCD 18
DROUT391
KKRC391b
RS 1
         FLOW
                0
                       0
                0.08 17000 0.0006
RC 0.08
         0.05
                                    0
* rc391b
          2
                                        1300
                                                2600
                      14
                             18
                                    28
RX 0
RY 1057
              1055
                     1050
                           1050
                                   1055 1055.5
         1056
KKADH401
KM Roseau River at Sout side Sec 31 T163N R39W at lateral JD61
KO 0
HC 2
        0 0 0 22
KKRC391m
```

KM Rose	au Rive	r Gage 15	to Lat	3 Judic:	ial 61				
KO 0	0	0	0	22					
RS 1	STOR	0	0						
* stor391	m								
SV 0	90	132	228	606	2187	2916	3579	4242	5460
* flow391									
SQ 0	500	1000	2000	3000	5000	6000	7000	8000	10000
KKRNF401		D.V. 700 0	- 20/00	m1 < 337 D	257				
		RNF20 Se			3 /W				
KO 0 BA 2.85	0	0	0	22					
	57	0							
LS 0 UC 6.27	9.41	U						•	
* rnf401	2.41								
UA 0	0	0.01	0.03	0.09	0.19	0.29	0.51	0.78	0.95
UA 1	J	0.01	3.05	0.05	****				
KKRCH401									
KM Lat	3 JD61								
KO 0	0	0	0	22					
RS 1	FLOW	0	0						
RC 0.08	0.05	0.08	5120	0.006	0				
* rch401									
RX 0	5	10	19	27	36	143	243		
RY1079.1	1079	1078	1075	1075	1078	1079	1079.1		
KKRNF402									
KM Norl	and Sub	RNF30							
KO 0	0	0	0	22					
BA 6.43			•						
LS 0	54	0							
UC 39.75	79.5								
* rnf402									
UA O	0.19	0.33	0.56	0.79	0.87	0.92	0.93	0.95	0.99
UA 1									
KKADH402		0	0	22					
KO 0 HC 2	0	U	U	24					
KKDVT402									
KM 50-50 s	nlit we	et and no	rth						
DTOUT402	piic we.	oc and m	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
* in402									
DI O.	10.	20.	30.	40.	50.	100.	200.	500.	1000.
* out402									
DQ 0.	5.	10.	15.	20.	25.	50.	100.	250.	500.
KKRCH402									
KM Lat	3 JD61								
KO 0	0	0	0	22					
RS 1	FLOW	0	0						
RC 0.08	0.05	0.08	10320	0.006	0				
* rch402									
RX 0	5	10	22	30	42	47	252		
RY1075.1	1075	1074	1070	1070	1074	1075	1075.1		
KKRNF403									
KM Norl	and Sub								
KO 0	0	0	0	22					
BA 5.66		_							
LS 0		0							
UC 13.51	13.51								
* rnf40 UA 0	0 1	0.30	٥.	0.63	0 74	Λ 0	0 06	0 91	0 95
UA 1	0.1	0.29	0.5	0.62	0.74	0.8	0.00	0.91	0.95
KKADH403									
KCADH403	n	0	0	22					
HC 2	U	U	U	24					
KKRCH403									
KM Lat	3 JD 61								
Luc	_ 55 51								

```
0 0
FLOW 0
KO 0
                              22
RS 1 FLOW
                         0
                             0.006
RC 0.08
         0.05
               0.08
                       9650
* rch403
           5
                 10
                                            47 252
RX 0
                        22
                               30
                                     42
                                          1070 1070.1
RY1070.1
         1070
                 1069
                       1065
                              1065
                                     1069
KKRNF405
KM Norland sub RNF60
                         0
KO
    0 0 0
                                22
BA 7.08
LS 0 55
UC 11.04 11.04
* rnf405
                                                 0.9
                                                       0.97
                                                                0.99
UA 0
UA 1
                                    0.65 0.82
                       0.31
                              0.51
          0.08
                 0.18
KKADH405
KM Sec 21/22 T163N R38W
KO 0 0 0 0 HC 2
                          0
                                22
KKRNF406
KM Norland sub RNF65
KO 0 0 0
                          0
                                22
BA 1.71
LS 0
UC 5
          46
         5.85
* rnf406
                              0.45 0.57 0.7
                                                 0.8
                                                       0.89
                                                              0.97
UA 0
UA 1
          0.13
               0.25 0.34
KKADH406
KM Sec 21/22 T163N R38W
KO 0 0 0
HC 2
                                22
KKRNF408
KM Norland Pool area RNF70 KO 0 0 0
                                22
BA 7.65
LS 0 48
UC 12.55 18.83
          48
                  0
* rnf408
UA 0
UA 1
                       0.15
                              0.26
                                     0.41
                                            0.61
                                                 0.75
                                                       0.87 0.93
          0.02
                 0.08
KKADH408
KO 0
HC 2
                  0
                        0
                                22
           0
KKDVT408
KM Split Norland flows into BR 5 Lat 3 and Lat 3 flows
DTOUT410
* in410
                     239.
                              443.
                                     696. 1065.
                                                 1515.
                                                       2032.
DI 0.
          35.
               99.
* out410
                                     232.
                                           355.
                                                  505.
                                                         677.
DQ 0.
          11.
                 33.
                      80.
                              148.
KKRCH420
KM Lat 3 JD 61
               0
KO 0 0
RS 2 FLOW
                       0
                                22
                   0
                          0
RC 0.125
                     24200 0.0006
               0.125
          0.05
* rch420
           6
                        18
                                           1320
                                                  1325
                               24
                                      34
RX 0
                  8
RY 1054
         1051
                1050
                       1045
                              1045
                                     1050
                                           1050
                                                  1054
KKADH421
KO 0
HC 2
           0
                  0
                        0
                                22
KKRCH421
KM Roseau River Lat 3 JD 61 to Hwy 310 KO 0 0 0 0 0 22
```

```
RS 1 STOR 0 0
* stor421
                                   7611 10140 12450 14757 18993
SV 0
                            2106
          312
                459
                    792
* flow421
                                         6000
                                                7000
                                                      8000 10000
SQ 0
              1000
                      2000
                            3000
                                   5000
KKRTV430
KM Br 5 Lat 3 JD61
DROUT410
KKRCH430
RS 4
         FLOW
                0
                        0
         0.05 0.125 44000 0.0004
RC 0.125
* out410
          6
                                        1320
                                               1325
RX 0
                                   34
                 8
                      18
                             24
RY 1054
         1051
               1050
                      1045
                            1045
                                   1050
                                         1050
                                               1054
KKADH430
KO 0
HC 2
          0
                0
                        0
                              22
HC
KKRNF499
KM Local drainage Roseau River at MN Hwy 310 KO 0 0 0 0 22
BA 19.26
         49
LS 0
                0
UC 18.59 32.35
* fan
UA 0
        0.05 0.15 0.35
                            0.65
KKADH499
KM Roseau River at MN Hwy 310
                            22
        0 0
KO 0
HC 2
HC
KKRNF520
22
BA 22.42
         51
LS 0
                  0
UC 43.2
        64.8
* fan
UA 0
         0.05
               0.15
                      0.35
                            0.65
KKRNF530
KM West Fork of Sprague Creek KO 0 0 0 0 0
        0 0
                              22
BA 20.42
         45
                  0
LS 0
UC 48.32 72.48
* fan
         0.05
               0.15
                      0.35
                            0.65
UA 0
KKADH530
KO 0
HC 2
                 0
                      0
          0
KKRCH530
KM Sprague Creek forks to Vasser Road
KO 0 0 0 0 22
RS 6 FLOW 0 0
RC 0.125
        0.04
              0.125 40765 0.0006
* rch530
         10
RX 0
                                   540
                                        1040
                                               1050
              510
                     516
                            534
RY 1080
        1075
              1073
                    1067
                           1067
                                  1073
                                       1075
                                               1080
KKRNF540
KM Local drainage to Sprague Creek at Vassar Road KO 0 0 0 0 22
BA 47.64
LS 0
         51
                 0
UC 43.35 65.03
* fan
UA 0
              0.15 0.35
        0.05
                            0.65
KKADH540
```

```
KO 0 0 0 0 22
HC 2
KKRCH540
KM Sprague Creek Vassar Road to Mud Creek
KO 0 0 0 0 22
RS 5 FLOW 0 0
         0.04 0.125 56058 0.0005
RC 0.125
* rch540
         10 510 516
RX 0
                            534
                                  540
                                       1040
                                              1050
                          1062
        1070 1068 1062
                                  1068
                                        1070
RY 1075
KKRNF545
KM Local drainage Sprague Creek at Sprague Manitoba KO 0 0 0 0 22
BA 21.93
         57
                0
LS 0
UC 35.7
        53.55
* fan
UA 0
        0.05 0.15 0.35
                            0.65
KKADH545
KM Sprague Creek at Sprague
KO 0 0 0
HC 2
                              22
KKRNF510
KM Local Drainage to Mud Creek
KO
    0 0 . 0 0
                              22
BA 32.18
        59
LS 0
UC 71.13 106.7
* fan
UA 0
        0.05
              0.15
                      0.35
                            0.65
                                    1
KKADH546
          0
KO 0
                0
                       0
                              22
HC
     2
KKRCH546
KM Sprague Creek Sprague to USGS Gage
KO 0 0 0 0 0 RS 2 FLOW 0 0
         0.04 0.125 17973 0.0009
RC 0.125
* rch546
        10 510 516
10602 1057 1051
                            534
                                  540
                                        1040
                                               1050
RX 0
RY 1065
                          1051
                                  1057
                                        1060
                                               1065
KKRNF550
KM Local drainage Sprague Creek at USGS Gage
                     0 22
KO 0 0 0
BA 39.01
         55
LS 0
UC 52.83
        35.4
* fan
              0.15 0.35 0.65
UA 0
         0.05
KKADH550
KM Sprague Creek at USGS gaging station
KO 0 0 0 0 0 HC 2
KKRCH550
KM Sprague Creek USGS Gage to Lat 2 JD 61
KO 0 0 0 0 22
RS 3 FLOW 0 0
         FLOW
RC 0.125
         0.04
              0.125 32800 0.0006
* rch550
         50 1850 1856 1874
                                  1880
                                        2980
                                               3030
RX 0
RY 1050
                                        1047
                                               1050
        1047 1045 1039 1039
                                  1045
KKRNF570
KM Local Drainage to Upper Lat 2 JD 61 KO 0 0 0 0 22
BA 54.33
```

,

```
LS 0 60 0
UC 39.24 58.86
* fan
UA 0
           0.05 0.15 0.35 0.65 1
KKRTV402
KM Split flow out of RNF402
DROUT402
KKRCH571
            FLOW
                     0
RS 1
                  0.08 10420 0.0006
RC 0.08
            0.05
* rch571
            2
                    4
RX 0
                           10
                                    24
                                           30 1300
                                                          2600
RY 1081
                                           1079 1079.5
            1080
                   1079
                          1076
                                   1076
KKADH574
KO 0
HC 2
             0
                    0
                            0
                                     22
KKRCH574
KM Lat 2 JD 61
                           . 0
KO 0 0
RS 4 FLOW
                  0
0
                                     22
                             0
RC 0.125
            0.05
                 0.125
                         31460 0.0005
* rch574
                                                  2621
RX 0
                     5
                              9
                                    17
                                           21
                                                          2655
                  1042
RY 1047
            1046
                           1038
                                  1038
                                           1042
                                                  1043
KKADH575
KO 0
HC 2
             0
                    0
                            0
                                   22
KKRCH575
KM Sprague Creek Br2 JD 61 to Outlet
KO 0 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125
            0.04 0.125 9000 0.0005
* rch575
            15 1515 1521 1541
                                           1547
                                                  2547
                                                          2555
RX 0
RY 1036
           1033 1032 1026 1026
                                                  1033
                                          1032
KKRNF580
KM Local drainage to Sprague Creek at Outlet KO 0 0 0 0 22
BA 47.32
LS 0
UC 29
            62
                     0
          43.5
* rectangle
                                    0.8 1
UA 0 0.2 0.4 0.6
KKADH580
KM Sprague Creek at Outlet
KO 0 0 0
HC 2
                                     22
KKADH456
KM Combined flows Roseau River and Sprague Creek
KO 0 0 0 0 22
HC 2
KKRCH456

      KM
      Roseau Rive Sprague Creek to Roseau Lake Bed

      KO
      0
      0
      0
      22

      RS
      3
      FLOW
      0
      0

RC 0.125 0.035 0.125 27200 0.0002
* rch456
RX 0 1320 2640 2665 2718
RY 1035 1034.25 1034 1021.5 1021.5
                                          2743
                                                  4063
                                                          5390
                                          1034 1034.25
                                                          1035
KKRNF610
KM South Roseau Lake Bottom KO 0 0 0 0
BA 40.91
           53
LS 0
UC 10.48 7.02
```

```
* rectangle
UA 0 0.2 0.4 0.6 0.8
KKRNF620
KM North Roseau Lake Bottom
KO 0 0 0
                              22
BA 46.2
         55
LS 0
UC 40.11 40.11
* fan
UA 0
        0.05
              0.15
                      0.35
                             0.65
KKADH620
KM Roseau River at Lake Bed
KO 0 0 0 0
HC 3
                              22
KKRNF700
KM Local Drainage West Pine Creek
        0 0
KO
    0
                     0
BA 33.76
LS 0 43
                0
UC 56.23 37.67
* fan
UA 0
        0.05
              0.15 0.35 0.65
KKRCH700
KM West Pine Creek Manitoba Hwy 12 to East Pine Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
                           22
RC 0.125 0.05 0.125 1672 0.0014
* rch700
              1500 1510 1518
1090 1086 1086
RX 0
         750
                                   1528
                                         2278
                                                3000
RY 1100
                                                1095
         1095
                                   1090
                                         1091
KKRNF710
KM Local drainage East Pine Creek
KO
    0 0 0 0
BA 9.55
        41
LS 0
UC 20.36 13.63
* fan
UA 0
              0.15 0.35 0.65 1
         0.05
KKRCH710
KM East Pine Creek Manitoba Hwy 12 to West Pine Creek
KO 0 0 0 0 0 RS 1 FLOW 0 0
                            22
RC 0.125 0.05 0.125 2048 0.0014
* rch710
RX 0
              1500 1510 1516
1090 1086 1086
                                         2276
                                                3000
         750
                                   1526
RY 1095
         1091
                                   1090
                                         1095
                                                1100
KKADH710
KM Pine Creek near Hwy 12
KO 0 0 0
HC 2
                      0
                             22
KKRCH711
KM East and West Pine Creek to Diversion
KO 0 0 0 0 22
RS 1. FLOW 0
         0.05 0.125 19288 0.0014
RC 0.125
* rch711
RX 0
                                         5250
                                                6000
         750 3000 3010 3016
                                   3026
              1085
                     1081 1081
                                   1085
                                         1090
                                                1095
RY 1095
         1090
KKRNF720
KM Local drainage Pine Creek at Diversion KO 0 0 0 0 22
BA 16.68
LS 0
         49
                  0
UC 7.58
        5.08
* fan
```

```
UA 0 0.05 0.15 0.35 0.65 1
KKADH720
KM Pine Creek Upstream of Diversion
KO 0 0 0 0
                                 22
HC 2.
KKDVT720
KM Pine Creek Diversion
DTOUT720
* in720
                       500. 1000. 1250.
                                              1500.
                                                     2000.
DI 0.
           220.
                300.
* out720
DQ 0.
           220.
                273.
                       407. 740.
                                       850.
                                               850.
                                                      850.
KKRCH720
KM Pine Creek Diversion to Roseau County Road 118
KO 0 0 0 0 0 RS 3 FLOW 0 0
                              22
                               0.001
                 0.125 37815
RC 0.125
           0.04
* rch720
                                       1196
                                               1700
                                                      2410
RX 0
           600
                1180
                       1184
                                1192
                1045 10417
                                             1047
                                                      1050
RY 1050
          1047
                                1041
                                       1045
KKRNF790
KM Local Drainage at RCR 118
KO 0 0 0 0
                                  22
BA 20.29
LS 0
           56
UC 17.76 17.76
* rectangle
0 A11
           0.2
                0.4
                          0.6
                                 0.8
                                          1
KKADH790
KM Pine Creek at Lake Bottom
KO 0 0 0
HC 2
                                  22
KKADH699
KO 0
HC 2
           0
                   0
                            0
                                  22
KKRSV699
KM Roseau Lake Bottom
KO 0 0 0 0 RS 1 FLOW 0
                                  22
                            0
* stor699

        SV
        0
        500
        1100
        3000
        5580
        12970

        SV 60590
        74010
        84505
        144375
        179500
        203000

                                5580 12970 17860
                                                     28000
                                                           40000 52260
* flow699
SQ 0
SQ 3084
                                       1372
                                               1638
                                                      1924
                                                             2222
                                                                    2574
                         954
                                1136
           250
                 732
          3868
                 4494
                         5200
                                7500
                                      10000
* elev699
SE1017.1 1024.8 1026 1027
                                1028
                                       1029
                                               1030
                                                      1031
                                                             1032
                                                                    1033
                                       1038
SE 1034 1035 1035.5 1036
                                1037
KKRCH699
KM Roseau River Ross to Lins Bridge
KO 0 0 0 0 22
RS 2 FLOW 0 0
RC 0.125 0.035 0.125 24390 0.0005
* rch699
           9 3200
RX 0
                                       3331
                                               5271
                                                      5280
                       3232
                              3299
RY 1035
         1032
                1030
                       1014
                              1014
                                       1030
                                              1032
                                                      1035
KKRNF900
22
BA 41.99
           54
LS 0
                   0
UC 14.73
         9.87
* rectangle
UA 0
                0.4
                       0.6
                                 0.8
           0.2
KKADH900
```

```
KO
   0
        0 0 0 22
HC
     2
KKRCH900
KM Roseau River Lins Bridge to Big Swamp
KO 0 0 0 0 22
RS 2 FLOW 0 0
        0.035 0.125 24390 0.0004
RC 0.125
* rch900
                      67
                                   166
                                         2806
                                               5280
RX 0
          25
                35
                            134
RY 1035
        1030
               1028
                     1012
                           1012
                                   1028
                                         1030
                                               1032
KKRNF920
KM Local drainage upstream of Big Swamp
KO 0 0
              0 0 22
BA 24.09
LS 0
          59
                  0
        32.83
UC 32.83
* rectangle
UA 0
          0.2
                 0.4
                       0.6
                             0.8
                                    1
KKADH920
KO 0
HC 2
          0
                 0
                       0
                              22
KKRCH920
KM Roseau River to Roseau River Wildlife Management Pool 2 Outlet
KO 0 0 0 0 22
RS 52 FLOW 0 0
RC 0.125 0.035 0.125 13000 0.0004
* rch920
RX 0 2640
RY 1025 1024.5
                                   5380
                                        8020 10659
               5280
                      5296
                            5363
                                   1024 1024.5
                                              1025
               1024
                      1018
                           1018
KKRNF810 RRWMA Pool 1
KM Local Drainage to RRWMA Pool 1
KO
    0 0
              0
                     0
BA 24.88
LS 0
          58
UC 13.3
        13.3
* rectangle
UA 0
          0.2
                0.4
                       0.6
                             0.8
                                     1
KKRTV720
KM Pine Creek Diversion
DROUT720
KKRC720a
RS 3
         FLOW
                 0
                        0
RC 0.05
         0.05
               0.05
                    41517 0.0001
                                    0
* rc720a
RX 0
          10
                 28
                       42
                             52
                                    66
                                         84
                                                94
RY 1068
                      1056
                            1056
                                   1063
                                         1063
                                               1068
         1063
                1063
KKADH810
KO 0
HC 2
           0
                 0
                       0
                              22
HC
KKRSV810
KM RRWMA Pool 1
KO 0 0
RS 1 STOR
                0
                        0
                              22
                2415
                        0
* stor810
SV 2415
         2477
               3968
                      4899
                            4215
                                   4575
                                         5115
                                               5475
                                                      6415
                                                            6735
* flow810
SQ 0
                     235
                             460
                                    820
                                         1390
                                               1960
                                                      3035
                                                            4735
         8.4
                33
* elev810
SE 1035 1035.2 1035.5 1035.8
                            1036 1036.2 1036.5 1036.7
                                                     1037 1037.4
KKRNF820
0
                              22
BA 89.71
LS 0
UC 51 76.5
```

```
* fan
UA 0
                     0.35
                              0.65
          0.05
                0.15
KKADH820
KO 0
           0
                 0
                         0
                               22
HC
    2
KKRSV820
KM RRWMA Pool 2
KO 0 0
RS 1 STOR
                               22
                         0
                4450
* stor820
                              9500 10800 12800 14300 16540 19550
SV 4450
          5400
                6800
                       8400
* flow810
SQ 0
                 33
                        235
                              460
                                     820
                                          1390
                                                 1960
                                                       3035 4735
* elev820
                             1030 1030.2 1030.5 1030.7 1031 1031.4
SE 1029 1029.2 1029.5 1029.8
KKDVT820
KM Main outlet Roseau River, Emergency Spillway and Secondary Outlet
DTOUT820
* in820
DI 0.
          8.4
                33.
                       235.
                             460.
                                    820. 1390. 1960. 3035. 4735.
* out820
                0.
                       170.
                             370.
                                    700.
                                         1225. 1645. 2345.
                                                              3325.
DQ 0.
KKRCH821
KM Roseau County Ditch 17
KO 0 0 0 0 0 RS 1 FLOW 0 0
                               22
RC 0.125 0.035 0.125 3900 0.0001
* rch821
                                           2128
                                                 2134
RX 0
         1050
                2100
                       2108
                             2116
                                    2124
RY 1025 1022
               1020
                     1016
                            1016
                                    1020
                                           1022
                                                 1025
KKRCH822
KM Old Roseau River Channel
KO 0 0 0 0
RS 1 FLOW 0 0
                               22
RC 0.125 0.035 0.125
                       8800 0.0001
* rch822
RX 0
         500
                1400
                       1408
                             1548
                                    1556
                                           2500
                                                 4000
RY 1024
                                    1020
         1022
               1020
                     1016
                            1016
                                           1022
KKADH930
KO 0
HC 2
           0
                 0
                       0
                               22
KKRCH930
KM Roseau River Pool 2 outlet to Pool 3 outlet
KO 0 0 0 0 0 RS 2 FLOW 0 0
RC 0.125 0.035 0.125 15200 0.0004
* rch930
                                    5380
                                           8020
                                                10659
RX 0
         2640
                5280
                       5296
                             5363
RY 1020 1019.5
               1019
                                    1019 1019.5
                       1013
                             1013
                                                 1020
KKRNF830
22
BA 23.73
LS 0
          52
                  0
UC 12.5
         12.5
* fan
UA 0
         0.05
              0.15
                     0.35
                             0.65
KKRTV820
KM Pool 2 outflow to Pool3
DROUT820
KKADH830
   0
2
KO
           0
                 0 0
                               22
НC
KKRSV830
KM RRWMA Pool 3
```

```
0
KO 0
RS 1
        0 0
                               22
          STOR
                 2700
* stor830
                                     7750
                                            9700
                                                  12900 16650
                               6750
SV 2700
          3400
               4500 5800
* flow830
                                            1040
                                                  1925
                                                        2980
SQ 0
           8.4
               33
                       185
                               355
                                      620
* elev830
                                                  1026 1026.5
SE 1024 1024.2 1024.5 1024.8
                               1025 1025.2 1025.5
KKRCH831
KM Outlet Channel Pool3
                       0
KO 0 0 0
RS 1 FLOW 0
                                22
RC 0.125
               0.125
                        2920 0.0001
          0.05
* rch831
           700
                1400
                        1410
                               1420
                                      1430
                                             2100
                                                   3000
RX 0
               1021 1016
                                            1022
                                                   1023
RY 1023
                                     1021
                              1016
          1022
KKRCH832
KM Old Roseau River Channel
KO 0 0 0 0 0 RS 1 FLOW 0 0
          0.05 0.125 1150 0.0001
RC 0.125
* rch832
                                      1514
                                            2100
                                                   3000
RX 0
          700
               1400 1412
                              1512
RY 1023
          1022
                1021
                       1015
                              1015
                                      1021
                                            1022
                                                   1023
KKADH940
KO 0
HC 2
                 0
                         0
                                22
KKRCH940
KM     Roseau River pool 3 to end of Big Swamp
KO      0      0      0      22
RS      1     FLOW      0      0
RC 0.125 0.035 0.125 34000 0.0004
* rch940
RX 0 2640
               5280 5296
                                     5380 8020 10659
                              5363
                                     1018 1018.5
                                                  1019
RY 1019 1018.5
               1018
                      1012
                              1012
KKRNF950
KM Local drainage Big Swamp
KO 0 0 0 0 0
                                22
BA 88.82
LS 0
                   0
          63
UC 32.48 48.72
* rectangle
                                      1
UA 0
           0.2
                  0.4
                        0.6
                               0.8
KKADH950
KO 0
HC 2
            0
                  0
                         0
                                22
KKRSV950
KM Big Swamp Storage
KO 0 0 0
RS 1 STOR 0
                          0
                                22
                          0
* stor950
SV 0 2000
                              21000 29000 37000
                                                  45000 53000 69000
               6000 13000
* flow950
                                     2600
                                           2900
                                                  3200
                                                        3500
                                                                 4100
SO 0
           700
               1300
                      1900
                              2300
KKDVT950
KM Flow transfer to Two Rivers
DTOUT920
* in920
DI 0. 2000. 3513. 3699. 4403.
* out920
DQ 0.
         0.
               533. 619.
                             1083.
KKRCH950
KM Roseau River Big Swamp to USGS Gaging Station
KO 0 0 0 0 0 RS 3 FLOW 0 0
RS 3
          FLOW
```

```
RC 0.125 0.035 0.125 32900 0.0002
* rch950
                                    2295
                                           2900
                                                  3250
RX 0
          1600
                2200
                       2220
                              2275
RY 1020
          1018
               1015
                      1005 1005
                                   1015
                                           1018
KKRNF960
KM Local drainage to USGS Gage near Caribou KO 0 0 0 0 22
         0 0
BA 24.04
          53
LS 0
UC 24.04
        33.8
* rectangle
UA 0
                 0.4
                        0.6
                               0.8
KKADH960
KO 0
HC 2
                 0
                        0
                               22
KKRCH960
KM Roseau River Caribou to International Border
KO 0 0 0 0 22
RS 1 FLOW 0 0
RC 0.125 0.035 0.125 12200 .0003
* rch960
RX 0 1600
              2200
                     2220 2275
                                    2295
                                           2900
                                                 3250
RY 1015 1013
              1010
                     1000 1000
                                    1010 1013
                                                  1015
KKRNF999
KM Local Drainage Roseau River at Border KO 0 0 0 0 22
BA 9.56
LS 0 52
UC 13.78 13.78
                 0
* rectangle
UA 0
               0.4
                              0.8
          0.2
                     0.6
KKADH999
KM Roseau River at International Border
KO 0
HC 2
        0 0
                      0
KKRTV920
KM Diverted flow to Two Rivers
DROUT920
```

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